MAY 1961

ENGINEERING DATA FILE

Preventive Maintenance of Air Conditioning Systems *. . . page 155*

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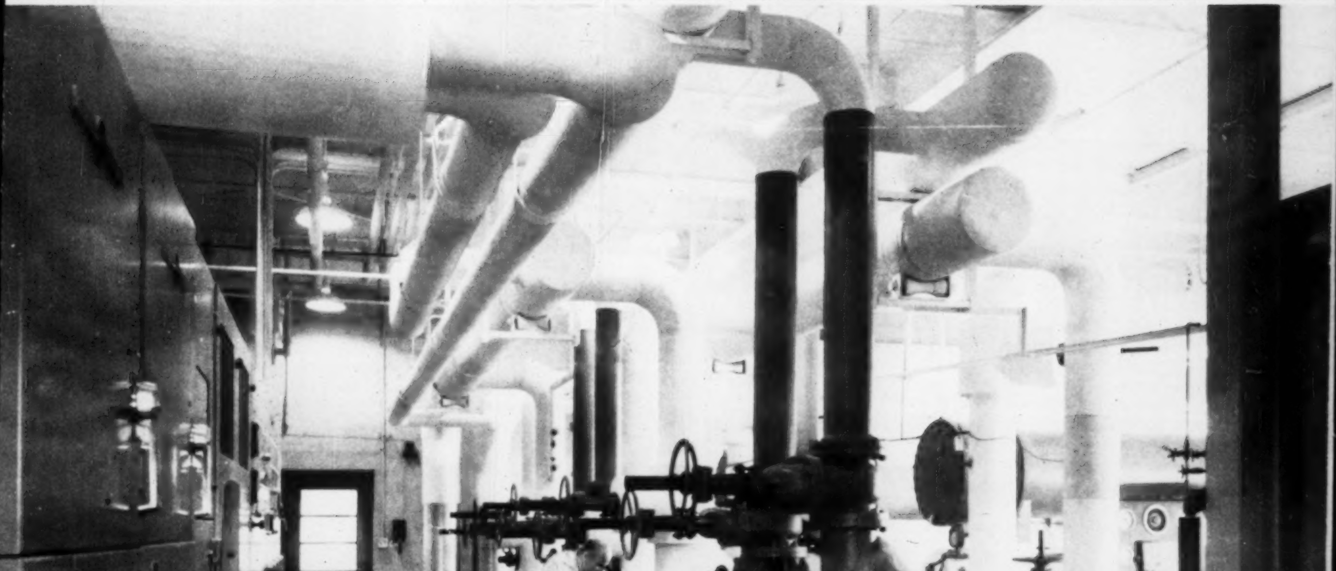
Heating Piping & Air Conditioning

. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings



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Charts for Refrigerant Riser Sizing Help Assure Oil Return to Compressor *. . . page 124*

Enrolled at Dynamic TULANE

MEN'S DORMITORY. MAIN ARCHITECTS: *Diboll-Kessels and Richard Koch; S. Wilson, Jr. & Associates.* GENERAL CONTRACTOR: *Farnsworth & Chambers.* MECHANICAL CONTRACTOR: *Cabirac Mechanical Contractors, Inc.* CONSULTING ENGINEERS: *Jos. E. Leininger & Associates.*

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for long-range dependability, long-time maintenance economy

"Dynamic" is the word for tradition-laden, prestige-rich, 127-year-old Tulane University in New Orleans.

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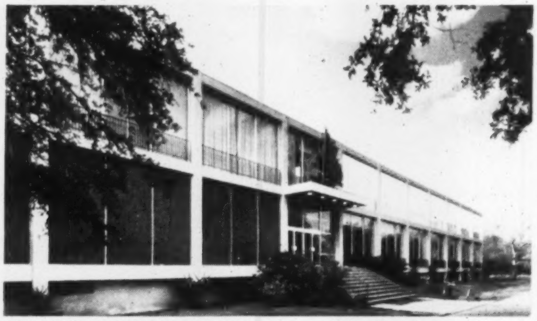
If you toured these buildings and the power plant which serves the campus complex, again and again and again you'd see the distinctive Diamond-mark that identifies Jenkins Valves. And small wonder: a university which had its beginnings more than a century ago just naturally thinks in terms of long-range dependability, long-time maintenance economy . . . precisely the qualities which make Jenkins Valves the "Standard of Quality" by which other valves are measured! Yet — and this fact still comes as a pleasant surprise to some specifiers — *they cost no more!* Jenkins Bros., 100 Park Ave., New York 17.

*Tulane's supervisory and liaison personnel for the building program: Harold E. Pique, Director of Planning; George F. Johnson, Director of Physical Plant; Charles E. Gilbert, Utilities Superintendent.

APARTMENT BUILDING *for married students.* MAIN ARCHITECTS: *Goldstein, Parham & Labouisse.* GENERAL CONTRACTOR: *J. A. Jones Construction Co.* MECHANICAL CONTRACTOR: *Sciambra & Masino.* PLUMBING CONTRACTOR: *Jas. F. O'Neil Co., Inc.* CONSULTING ENGINEERS: *Design Engineers & Associates.*



UNIVERSITY CENTER *features swimming pool, bowling lanes, radio station, cafeteria, ballroom.* MAIN ARCHITECTS: *Curtis & Davis and Associates; Edward Silverstein.* GENERAL CONTRACTOR: *Farnsworth & Chambers.* MECHANICAL CONTRACTOR: *Sciambra & Masino.* CONSULTING ENGINEERS: *Leo S. Weil; Walter B. Moses.*

POWER PLANT. *Boiler feed water pumps and Jenkins Valves shown.* MAIN ARCHITECTS: *Paul Charbonnet, Jr.* GENERAL CONTRACTOR: *Gervais Favrot Co.* MECHANICAL & PLUMBING CONTRACTOR: *Comfortaire Co., Inc.* CONSULTING ENGINEERS: *Leo S. Weil; Walter B. Moses.*

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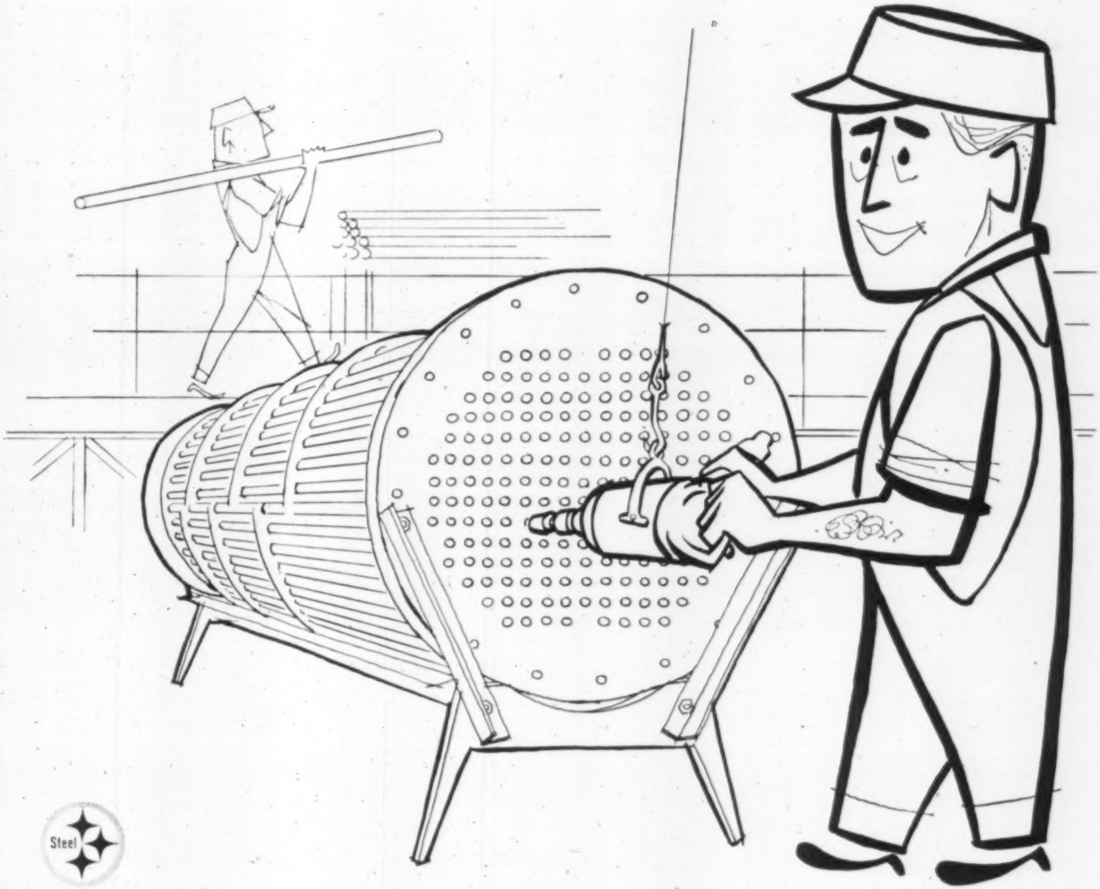

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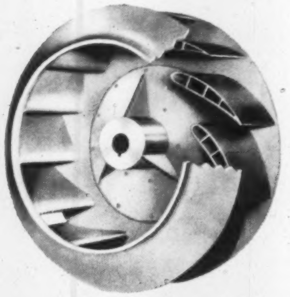

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Heating, Piping & Air Conditioning

FOR CONSULTING ENGINEERS, MECHANICAL (HEATING, PIPING, AND AIR CONDITIONING) CONTRACTORS, ENGINEERS WITH PLANTS AND BIG BUILDINGS

VOL. 33, NO. 5 MAY 1961

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NEW

VARIABLE VOLUME REHEAT is a part of an air conditioning system that supplies *varying quantities of air at a constant low temperature* to satisfy the changing cooling load and provides reheat for a minimum quantity of air during heating.

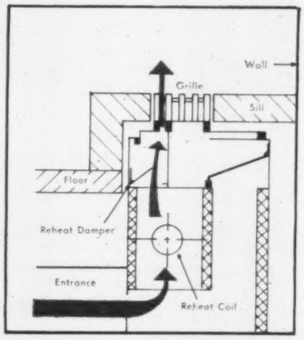
THE NEW *TITUS VARIABLE VOLUME REHEAT UNIT* PROVIDES MORE EFFICIENT PERIMETER AIR CONDITIONING, GREATER OVERALL ECONOMY—MORE FLEXIBILITY IN ARCHITECTURAL DESIGN

This new unit assures the utmost in complete and continuous control of individual space temperatures and ventilation the year around. *Each unit can respond to a wide range of heating and cooling demand — WITH AMAZING EFFICIENCY AND ECONOMY.* Can be used with low or high pressure systems.

LOWER INITIAL EQUIPMENT COSTS . . . As an example, fan capacity can be much less when Titus Variable Volume Reheat units are used. Due to solar orientation, all perimeter areas do not require maximum cooling or maximum flow at the same time. *With variable volume it is then possible to design the fan capacity by the cooling air flow required at a specified time, rather than the total of the maximum flow required at each outlet in the perimeter area* as would be the case with a constant air flow system.

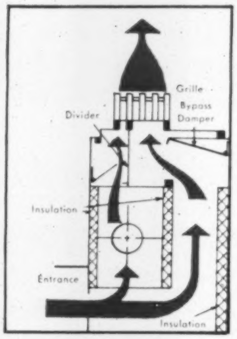
LOWER OPERATING COSTS . . . Operating costs are greatly reduced during heating because only about ¼ of the maximum flow need be supplied with Titus Variable Volume Reheat units. ADDITIONAL SAVINGS on heating equipment and fuel costs are realized from the low air flow since A MINIMUM OF COOL PRIMARY AIR IS REHEATED. Operating costs during cooling are less, too, because unit supplies *varying quantities* of cooled air to satisfy changing cooling load.

GREATER DESIGN FREEDOM FOR ARCHITECT . . . When conventional units such as convectors, mixing boxes, etc., are used in perimeter air conditioning, they often cause unsightly, cluttered walls. *The new Titus Variable Volume Reheat units can be installed under the floor with the outlet flush with the floor . . .* or above the floor at any height desired.



REHEAT AND MINIMUM FLOW THROUGH TITUS VVR UNIT

When heating is required, a damper shuts off about three-fourths of air flow through unit allowing minimum flow of cool air to pass through unit and be heated by finned tube. When reduced heating is called for, flow of hot water is gradually shut off until no heating of air takes place. Now unit very efficiently provides minimum cooling with same flow rate as before.



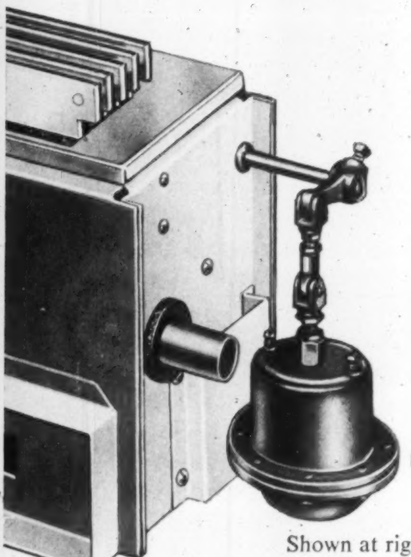
FULL COOLING AND MAXIMUM FLOW THROUGH TITUS VVR UNIT

When thermostat calls for more cooling, pneumatic motor begins opening by-pass damper and more air is then allowed to flow through unit until damper is full open and maximum flow and full cooling is reached. (Maximum flow is approx. 4 times greater than minimum flow). UNIFORM AIR DISTRIBUTION is possible with Variable Volume Reheat unit because the division of air flow through the grille provides a constant velocity leaving the grille.

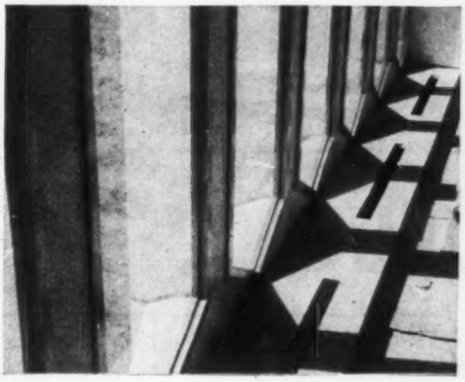
Variable Volume Reheat unit by TITUS®

* *developed in conjunction with Minoru Yamasaki . . . Smith, Hinchman & Grylls, Associated Architects and Engineers*

TESTED AND PROVED in a 2-story mock-up of the new Michigan Consolidated Gas Company Office Building in Detroit



PATENT PENDING



Shown at right is actual photo of new Titus Variable Volume Reheat units installed in mock-up of Michigan Consolidated Gas Company Office Building. The units were installed under the floor with a 3-inch pre-cast concrete sill containing Titus extruded aluminum Linear Grilles as outlets. *The new Titus VVR units fully met all requirements of the variable volume reheat system.* They proved capable of maintaining room temperature within 1 F—with varying heating and cooling loads.

MAIL COUPON FOR COMPLETE INFORMATION

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Please rush new CATALOG giving complete details on the new Titus Variable Volume Reheat unit.

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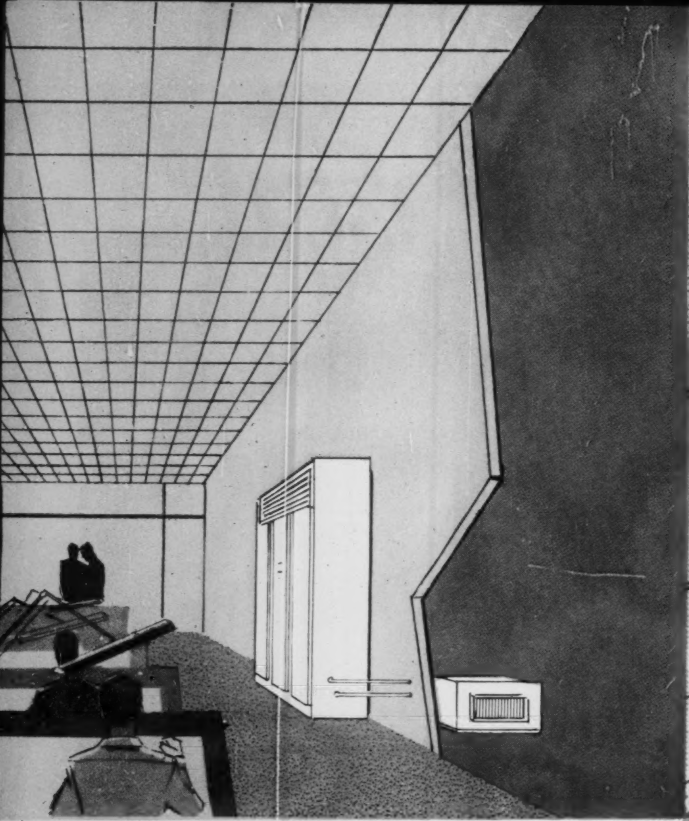
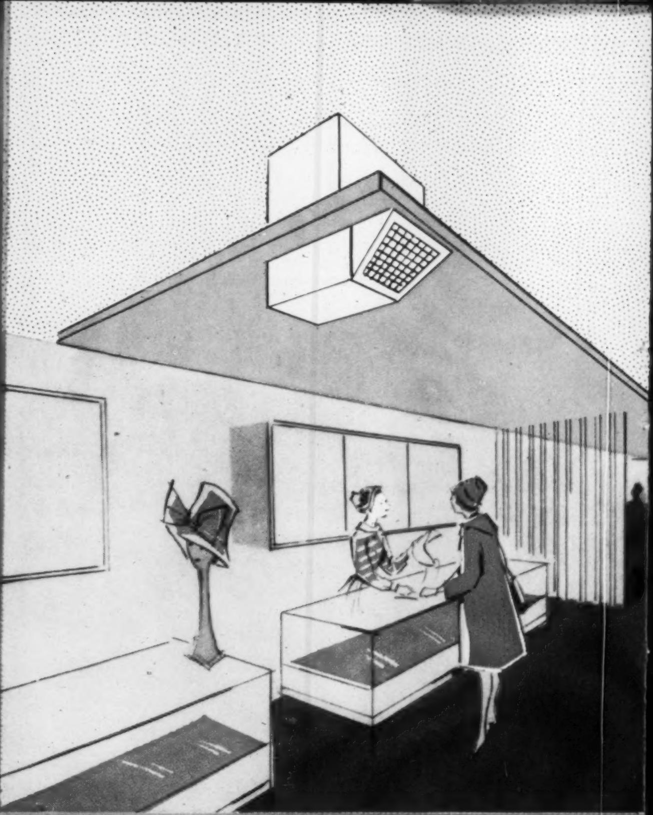
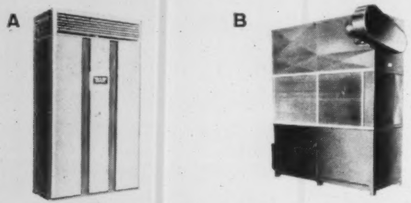
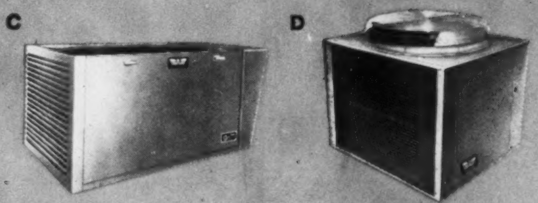






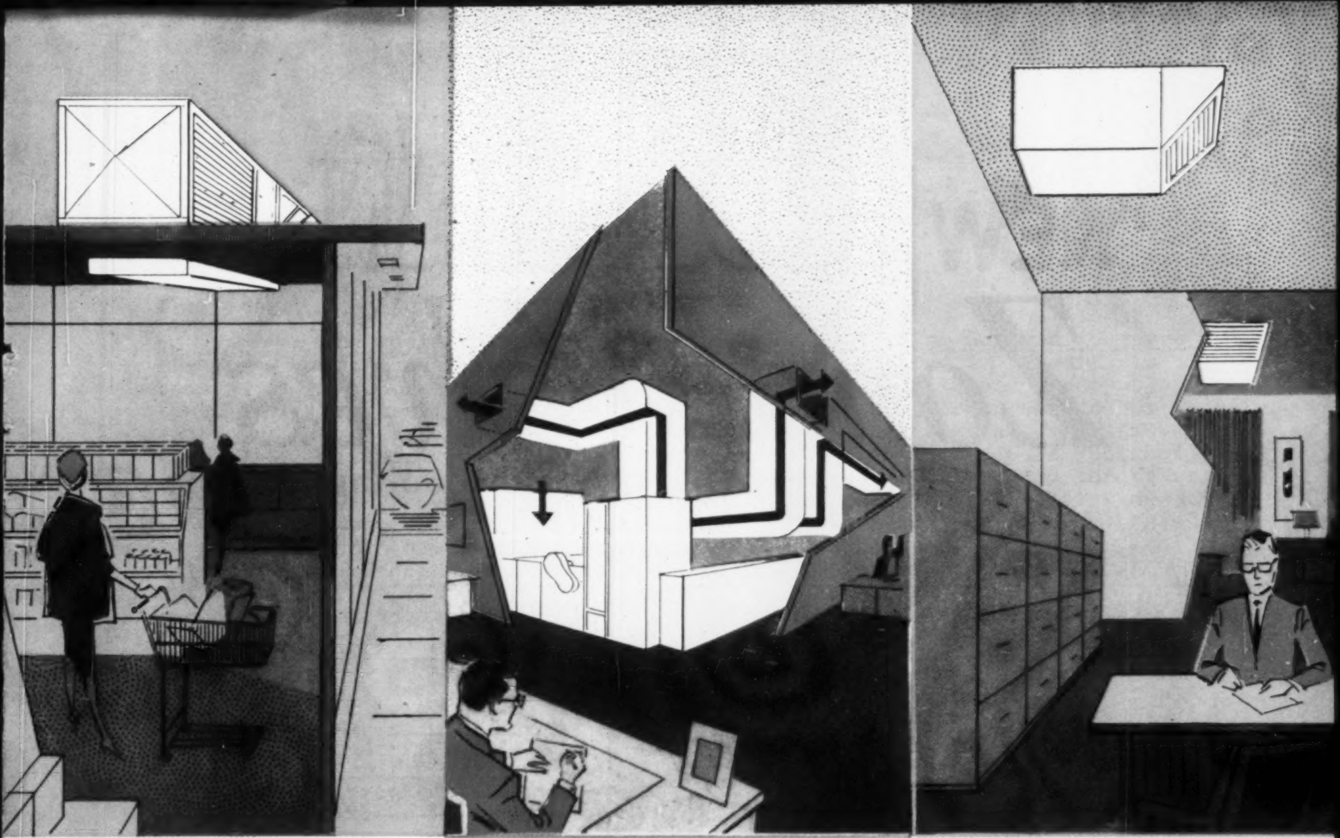
Water and air-cooled packaged units from 3 to 60 tons are compact, stylish and functional for in-space or remote application.

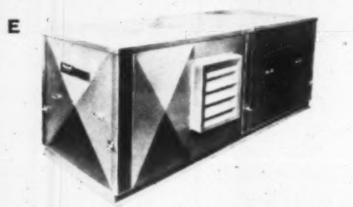


Completely wired remote air-cooled condensing unit with blower-coil units through 20 tons are ceiling-suspended or ducted to conditioned space.

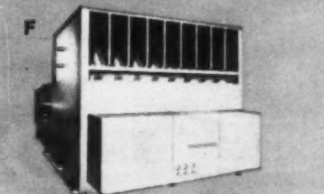
"FULL CHOICE" PACKAGES—MOST

PACKAGE TYPE	POSITION	ILLUSTRATED ABOVE	NOMINAL TONNAGES										
			3	5	7½	10	15	20	25	30	40	50	60
WATER-COOLED PACKAGES (Self-Contained Systems)	IN CONDITIONED SPACE												
	Floor-Mounted Vertical	A, G	●	●	●	●	●	●	●	●			
	Ceiling-Mounted Horizontal	G	●	●									
	REMOTE LOCATION												
	Floor-Mounted Vertical	A, B, G	●	●	●	●	●	●	●	●	●	●	●
	Floor-Mounted Horizontal	B, G		●	●		●	●	●				
	Ceiling-Mounted Horizontal	G		●	●								
AIR-COOLED PACKAGES (Split Systems)	REMOTE LOCATION												
	Floor-Mounted Vertical	A, B, G	●	●	●	●	●	●	●	●	●	●	●
	Floor-Mounted Horizontal	CD	●	●	●	●	●	●					
	Ceiling-Mounted Horizontal	CD	●	●	●	●	●	●					
	Floor-Mounted Multizone	F						●	●	●			
AIR-COOLED PACKAGES (Self-Contained Systems)	REMOTE LOCATION												
	Roof-Mounted	E		●	●	●	●	●	●	●			

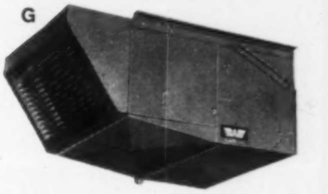




Up to 35 tons in a single package for year 'round cooling and heating—using gas, oil or steam for heating.



Compact, low-cost answer for true multi-zone system. Offers individual zone control from zero to one hundred per cent of system capacity.



Flexi-Cool units, water- or air-cooled, for ceiling suspension are completely self-contained and can circulate directly or through ducts.

COMPACT, EASIER TO INSTALL

From estimate to final installation, there's no easier line to use than Worthington "Full Choice" packaged air conditioning units. Why? For virtually every job, Worthington supplies more than one packaged system to make your work flexible, fast and profitable.

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Units may be floor-mounted or ceiling hung, either in conditioned space or remotely. An outdoor system can be roof-mounted or located at ground level on a suitable base. Use with or without ducts—get a variety of air discharge patterns with interchangeable grills and louvers. Special units with inherent capacity control handle multizone or special design situations.

To make design and selection easy, Worthington has complete information on this packaged "Full Choice" line in the booklet shown. Pricing is also simple and competitive.

You'll find these units install for less, too. Every possible step has been done at the factory. Water-cooled units are shipped factory assembled, internal piping and wiring is complete and refrigerants charged. Air-cooled units are split systems, shipped in just two pieces. Only utilities and ductwork, if required, must be supplied.

FULL CHOICE PACKAGE AIR CONDITIONERS

For full information, ask your Worthington representative for the booklet shown here. Or write Worthington Corporation, Air Conditioning Division, Dept. 12-45, East Orange, N. J. In Canada, Worthington (Canada) Ltd., Brantford, Ontario.

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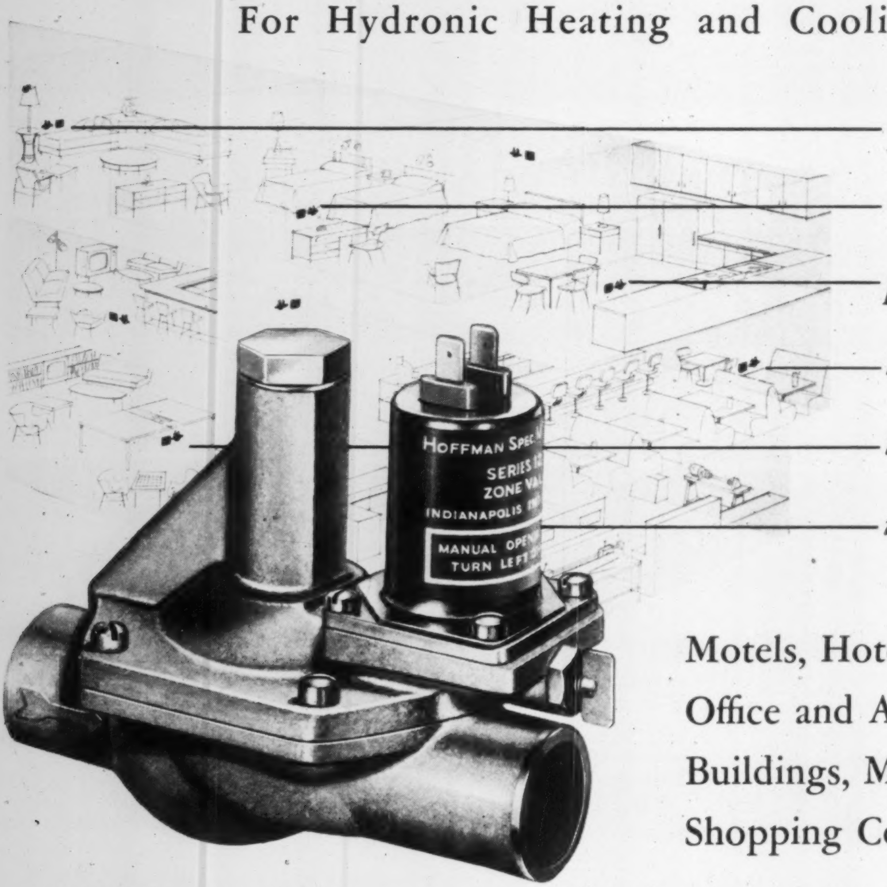

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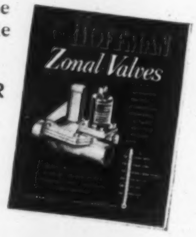
With Hoffman Zonal Valves, temperature can be precisely and individually controlled in each living, working, or playing zone . . . in small 2-zoned residences as well as large multi-zoned structures. Designed for use on modern 2-pipe hydronic heating and cooling systems, Hoffman Zonal Valves are compact in size (only 2⅝" wide for small-area installations), operate noiselessly (can be installed in bedrooms), and close completely (there's no leak-through to waste fuel). *Free*, fact-filled literature detailing information on these diaphragm-type Zonal Valves and zone control system components is available from your wholesaler or Hoffman.



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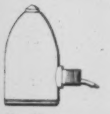
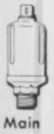
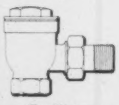
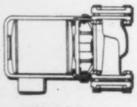

Radiator Vents


Main Vents


Radiator Traps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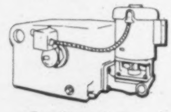
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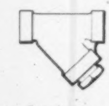

Strainers

HOFFMAN SPECIALTY MFG. CORP. 1700 W. 10th Street, Indianapolis 7, Indiana

LETTER FROM THE EDITOR

May 1961

Dear Reader:

The radiant heating system designed by William Goodman to serve the large Cabrini apartment project in Chicago is featured in the article on page 115. Low operating and maintenance costs were a must, and these objectives have been accomplished. How this low-temperature, low-pressure hot water system was designed to achieve these requirements with a temperature drop of 90 F is explained in this article. The radiant coils were designed and installed to distribute one-half of the heat output upward and the other half downward. Operating data is included in the article which indicates the economy of operation. Clifford E. Koyen, chief operating engineer for this large housing project consisting of almost 2000 apartments, was interviewed during the preparation of the article and he said in his 25 years of engineering experience he has never operated a heating system with such ease, lack of operating problems, and with such a small amount of maintenance effort. This is an interesting job based upon good engineering proved through operating experience.

In order to properly select cooling coils, a basic understanding of the psychrometric chart is necessary. A good down-to-earth review of the fundamentals involved is presented on page 119 by George C. Stevens. He also shows how to use coil selection tables by interpolating between available coils and tentative design conditions.

The charts and design procedure for sizing refrigerant risers presented by John P. Johnston in his article on page 124 represents much study and practical knowledge. Double refrigerant risers have long been used for suction and discharge lines in systems with variable capacity compressors. This method has been used to insure positive return of lubricating oil from the piping back to the compressor. Mr. Johnston has developed these useful charts which combine the variables of compressor capacity, system pressure loss, design temperatures, and critical velocity to permit an easy determination of riser size to produce proper oil return. The charts also show when single velocity risers can be used without causing adverse effects on the system balance.

Planning and designing the heating and air conditioning systems for TV stations requires much care to meet the stringent demands imposed by the high internal heat gains. Joseph E. Leininger explains how this was done for WWL-TV in New Orleans in his article on page 131. To prove that his design was right, Mr. Leininger waited to report what and why it was done until the systems had operated for three years. Only minor suggestions for improvements have been made. The control features in this installation are especially interesting because of the complex requirements. Of course the methods used to control sound and vibration are very important also.

Air curtain doorways are receiving a great deal of attention these days, both pro and con. Another interesting air curtain application is presented this month on page 136. C. F. Mowery is the author. This air curtain doorway answered the need for safe and fast access into a large plant basement. Since the entrance and exit openings form a pair, it made it possible to "compact" the installation. Total air flow at each door is 44,000 cfm, delivered by two vaneaxial fans through short flexible ducts to adjustable vanes which direct the air at an angle of 30 degrees across the opening. Mr. Mowery reports that the operation of the air curtain doorways has been very satisfactory.

LETTER FROM THE EDITOR (continued) --

More solar irradiation tables are presented in the article on pages 138 to 142. This article is Part 2 of the series of three articles on this subject. The first article appeared in the April issue. Professor F. W. Hutchinson and M. O. Cotter have prepared these helpful tables which contain all-year irradiation data for surfaces which are inclined toward the sun. These tables this month apply to walls that are either east or west facing and inclined outward from the base. The article next month will contain the tables for inclined walls facing southeast and southwest.

When water is being considered for industrial cooling applications, how can the kind and amount of water available be determined? John F. Hoffman answers this question and others in his article on page 143. Many factors are discussed which influence storage, replenishment, water movement, and contamination to assure a good dependable supply. If underground reservoirs are available, extensive investigation must be made into the character of the reservoir which underlies any particular location. Mr. Hoffman explains how these determinations may be made and what results may be expected.

How comfort was provided in the steam pressing department of a clothing manufacturing plant is told by Alfred C. Jutzi in his article on page 148. Mechanical cooling, evaporative cooling, and a mechanical ventilating system were all considered for the solution. However, it was decided that the most important problem that needed a solution was to remove the steam vapors at their source to achieve the desired results. An aluminum hood was fabricated and attached directly to the head of the steam presses in order to collect the steam vapors before they were released into the room. Flexible tubing connected the hoods to an exhaust fan. The results experienced with this system have been completely satisfactory.

To install a central air conditioning system in an existing laboratory where the work could not be interrupted was not easy, but it was done in the Merck Sharp and Dohme research facility in West Point, Pa. recently. Richard W. Rodney explains how it was done in his article on page 150. A reheat design was selected to achieve the desired control resulting from fluctuating internal loads and to take advantage of existing ventilating units and ducts. Separate contracts were let for the mechanical, electrical, and building alteration work, and Mr. Rodney points out that this arrangement worked out satisfactorily with little disruption or deviation from schedule.

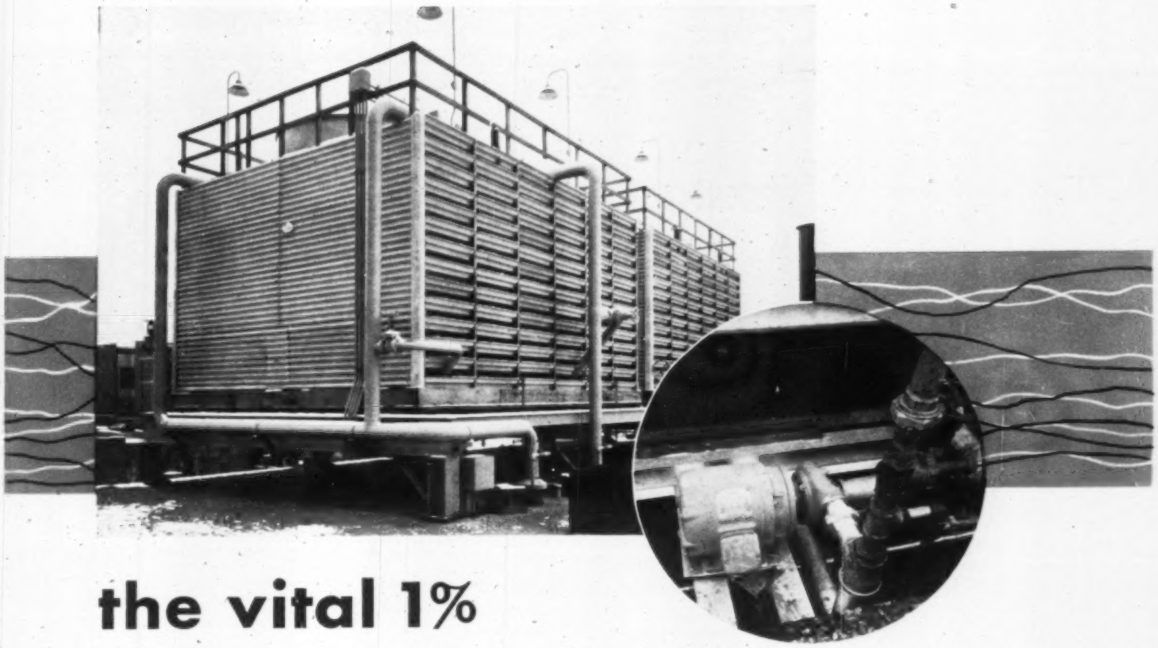
The annual directory of addresses of engineering societies and associations has been brought up to date again and is presented as the HPAC Data Sheet on pages 153 and 154. I suggest that this be torn out and saved.

To help you with your maintenance program, Don Bahnfleth, Engineering Editor, has prepared the HPAC Engineering Data File on pages 155 to 170 this month on the subject of air conditioning system maintenance. No one will deny the growing importance of proper operation and maintenance of these systems. Not only are the systems more complex and require more attention to achieve the desired operating results, but space for maintenance imposes a constant problem as does the lack of trained personnel. This report outlines the special maintenance needs of air conditioning systems, and it presents a guide on what to inspect, how often, and why, for establishing a preventive maintenance program. However, these suggestions must be adapted to local conditions and particular systems because of severity of service, reliability required, environment, abuse, etc. I know you will find this to be another valuable reference piece.

Don't miss the You'll Want to Know items on pages 43 to 46 and 226 to 240. Also of interest each month are the comments from readers in the "Open for Discussion" pages, and this month these comments are on pages 97 to 108.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING



the vital 1%

In an air conditioning installation, the pump seldom exceeds 1% of the total cost, but the importance of this 1% is obvious . . . if the pump breaks down, the entire system fails. The proven dependability and lower maintenance costs of Ingersoll-Rand Motorpumps are only two reasons why they are the leader for such important applications. I-R Motorpumps simplify installation because they are compact. They operate in any position and they are available in a wide range of types and sizes to meet any requirement.

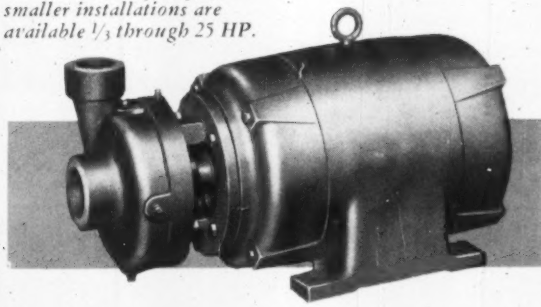
over a century IR *of pump progress*

from the leading manufacturer . . .

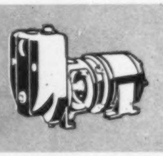
Ingersoll-Rand

81A9 **11 Broadway, New York 4, N. Y.**

"K" line Motorpumps for smaller installations are available 1/3 through 25 HP.

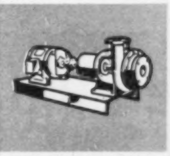


OTHER I-R PUMPS AVAILABLE



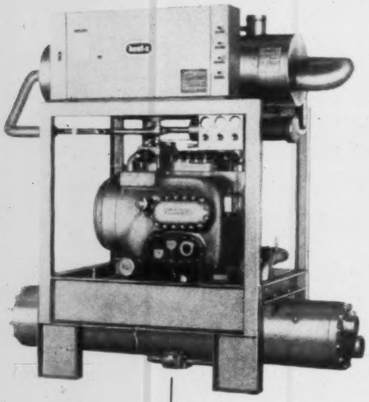
Self-priming pumps

Horizontally split pumps



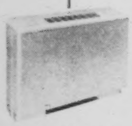
Cradle mounted pumps

You Can't Beat the

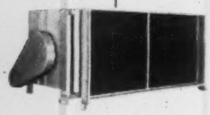


CHILLED WATER AIR CONDITIONING SYSTEMS

Development of packaged water chillers such as the Heat-X 'PC' units has done much to popularize the use of chilled water as a cooling medium for air conditioning. Reasons for the systems' popularity include: dual use of the same piping network for heating and cooling; economy in piping installation costs; simplified, more economical maintenance; variable capacities available within the framework of existing equipment; simpler, personalized temperature control; less stringent code requirements. Heat-X Package Chillers, used in conjunction with many Dunham-Bush units (as illustrated), offer a wide variety of chilled water air conditioning systems.

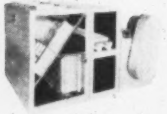


'CR' Fan-Coil Units. For motels, hotels, residences, institutions

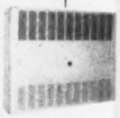


'AH' Air Handling Units. For hospitals, office buildings, bowling alleys, manufacturing areas, supermarkets.

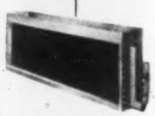
'CC' Comfort Conditioner Units. For office buildings, bowling alleys, light manufacturing, supermarkets, warehouses.



'MZ' Multi-Zone Units. For institutions, theaters, schools, plant offices.



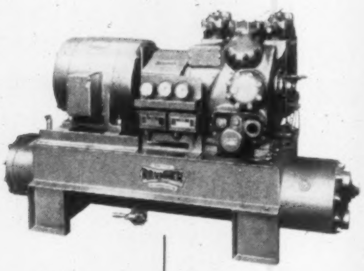
'CHC' Cooling-Heating Wall Unit. For motels, small medical offices.

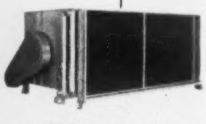


Water Coils (DX Coils where applicable). For laboratories, industrial air conditioning.

DIRECT EXPANSION AIR CONDITIONING SYSTEMS

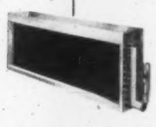
Availability of easy-to-install air handling units and compactly constructed refrigeration condensing units such as the modern design Brunner Multi-Drive line has led to a change in thinking about direct expansion air conditioning systems. Wider temperature ranges are available, better control of relative humidity for various processing applications are some of the key advantages of direct expansion systems.





'AH' Air Handling Units. For hospitals, office buildings, bowling alleys, manufacturing areas, supermarkets.

'MZ' Multi-Zone Units. For institutions, theaters, schools, plant offices.



Water Coils (DX Coils where applicable). For laboratories, industrial air conditioning.

DUNHAM-BUSH

DUNHAM-BUSH Systems

DX AIR COOLED SYSTEMS

Reasons why the Dunham-Bush 'LSCU' (or 'LRCU') Remote Condensing Units have such popular appeal in the air conditioning picture today include: low initial investment, elimination of water supply and disposal problems through use of air cooled condensers, simplified maintenance, flexibility of condenser location and element-proofed construction (permitting outdoor installation with space saving and elimination of noise problems).

'CC' Comfort Conditioner Units. For office buildings, bowling alleys, light manufacturing, supermarkets, warehouses.

'AH' Air Handling Units. For hospitals, office buildings, bowling alleys, manufacturing areas, supermarkets.

Water Coils (DX Coils where applicable). For laboratories, industrial air conditioning.

No need to improvise or compromise when you specify DUNHAM-BUSH. There's a system designed to meet **your** specific needs!

And behind every Dunham-Bush product is the peace of mind reassurance represented by the company's half century of experience in the design and manufacture of quality air conditioning, refrigeration and heating products.

This reassurance underlies the increasing tendency among top consulting engineers to specify products by DUNHAM-BUSH—the company that's on the move . . . setting the pace in **modern** air conditioning.

On your next job, contact the DUNHAM-BUSH man . . . you'll find him helpful, experienced, reliable.

DUNHAM-BUSH, INC.

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SALES OFFICES LOCATED IN PRINCIPAL CITIES

Dependable Natural Gas Power...

A milestone in public education was reached this year as a Clearwater, Florida school experiment set out to compare air-conditioning operating costs and student achievements. Although building contracts for the new schools were comparable, the air-conditioned school, above, actually cost less to build because design was more compact, with reduced roof and corridor construction. At left, 7th grade science students stay cool and fresh, sustain interest throughout the day in climate controlled classroom.

Florida project relies on International engines to keep operating expense at reasonable level...

A new era for municipal air-conditioning may be the result of a school project getting underway in Clearwater, Florida. It is believed that climate control in the classroom will improve student comfort, promote alertness, reduce illness and absenteeism, and generally upgrade the education of our children. Although industry has universally accepted the merits of air-conditioning, school and municipal officials question its value when confronted with the cost and operating expense of reliable cooling equipment. The Clearwater project will answer this question.

The project began with construction of two junior high schools—the Oak Grove School in Clearwater and the Pinellas Park School in St. Petersburg—each one comparable in cost and capacity. The Clearwater school is air-conditioned, the other is not. Comparison of operating expenses and educational achievements during the 1961-62 season will determine if climate control is worth the extra appropriation.

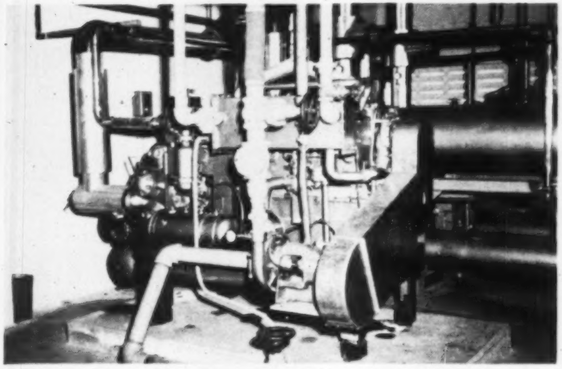
To keep operating costs at a minimum, school officials chose a natural-gas-powered system with outstanding characteristics of economy and efficiency—two Ready-Power 60-ton units driven by two International U-450 engines. The IH-powered system operates from 9:30 am to 4:30 pm, bringing classroom temperature to the desired level within 30 minutes. Water enters the line at approximately 90° F and leaves the system at 48° F. Return water is approximately 51° F. The separately-housed system keeps 24 classrooms and the gymnasium at about 72° F regardless of outside temperatures.

When you turn to International for air-conditioning power, you join an ever-increasing number of engineers and contractors who specify IH engines for dependable, low-cost installations. The wide range of sizes in the IH line—35 diesel and carbureted models from 16.8 to 385 max. hp—gives you matched power for all heavy-duty jobs. For complete information contact International Harvester Co., Engine Sales Dept., Melrose Park, Ill. For specific information on air-conditioning, fill out the coupon on the page opposite.

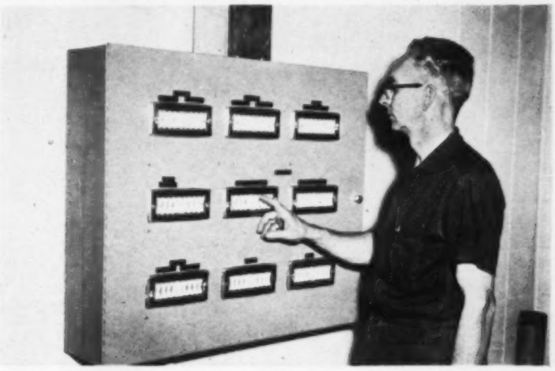
INTERNATIONAL® ENGINES

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

New Key to Low-Cost Municipal Air Conditioning



Officials who specified cooling equipment for the Clearwater project naturally turned to the most economical units they could find. Two natural-gas-powered International U-450 engines drive two Ready-Power water chillers in this low-cost system. Installations throughout the country indicate that International engines provide the most economical air-conditioning power available.



Operating Engineer J. E. Pratt controls temperature of each room and gymnasium from this master panel. Each classroom accommodates 35 students. The school began with 665 students, now has a total enrollment of 1,200. Provisions have been made for additional air-conditioning equipment as extra rooms are added to the present facility.

For descriptive literature spelling out the advantages of International natural gas powered air-conditioning, send for colorful, illustrated booklet. Fill out the coupon and mail it today!

Mr. R. R. McKiel
Engine Sales Dept.
International Harvester Co.
Melrose Park, Ill.

Please send me the booklet on natural gas air-conditioning.

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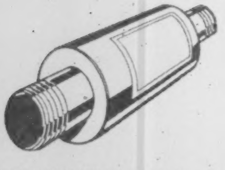
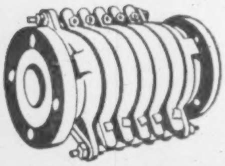
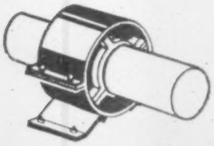


FLEXONICS Model H Expansion Compensator —in sizes to 3", for pressures to 175 p.s.i., absorb 2" total pipe motion at each unit.

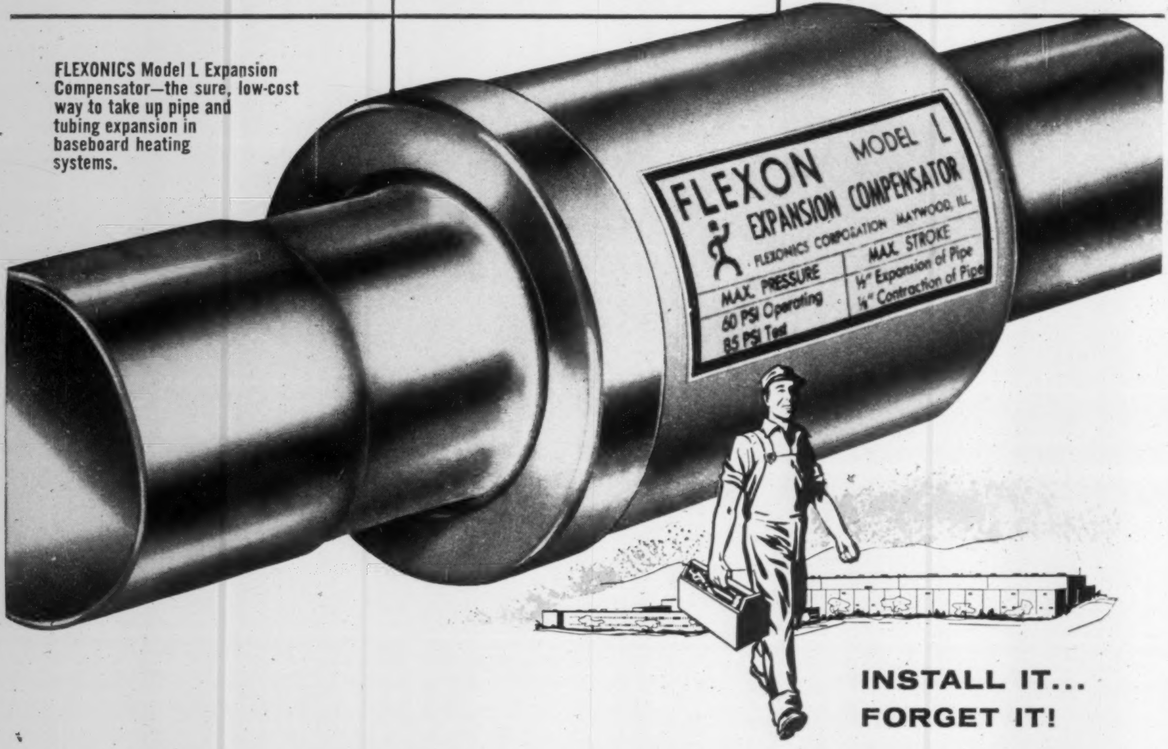


FLEXONICS Expansion Joints — controlled-flexing, free-flexing, and many special types, in an unlimited range of sizes.



FLEXONICS Pipe Guides—a completely new and better way to keep pipe in alignment. Positive, rugged, inexpensive.

FLEXONICS Model L Expansion Compensator—the sure, low-cost way to take up pipe and tubing expansion in baseboard heating systems.



INSTALL IT...
FORGET IT!

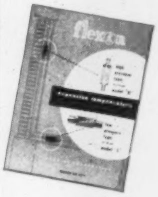
ENGINEERS ACROSS THE COUNTRY ARE SPECIFYING FLEXONICS MODEL L PACKLESS EXPANSION COMPENSATORS

You'll find FLEXONICS Model L Expansion Compensators written into the heating specifications for the finest, most modern buildings across the country. There's no substitute for their completely packless design, their easy installation, and the fact that they *never need maintenance!*

There's no easier or lower-cost way to take care of pipe and tubing expansion and eliminate water hammer noise, especially in baseboard convector installations. Install a FLEXONICS Expansion Compensator in minutes—forget it for the life of the building.

They have been proved in thousands of installations. Why not write them into your next job? Write today for cost data, and the name of your FLEXONICS representative.

Today—write for informative and helpful Catalog



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290 East Devon Avenue • Bartlett, Illinois

FLEXIBLE METAL and SYNTHETIC HOSE
EXPANSION JOINTS
BELLOWS • SPECIAL TUBULAR ASSEMBLIES

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FLEXONICS CORPORATION OF CANADA, LTD.
BRAMPTON, ONTARIO

ATTACH TO YOUR LETTER-HEAD—MAIL TODAY!

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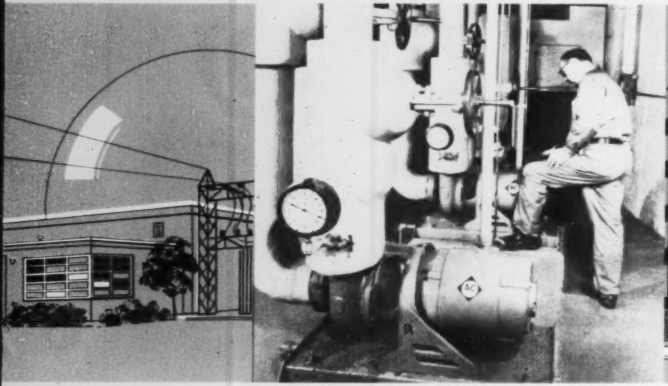
Please send me my personal copy of Flexonics Catalog 205, including full information on using Flexonics Expansion Compensators to absorb pipe movement.

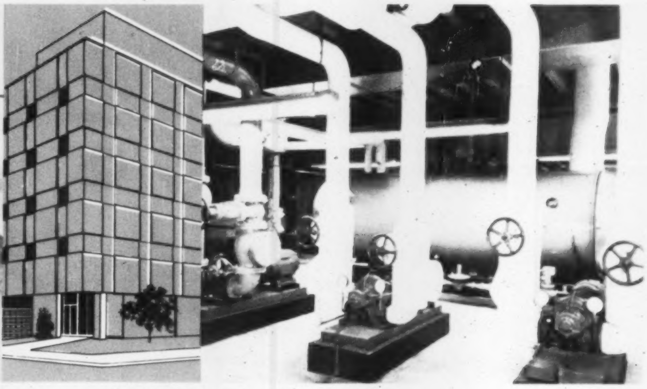
When you select pumps and motors for air-conditioning service...

Specify Silence

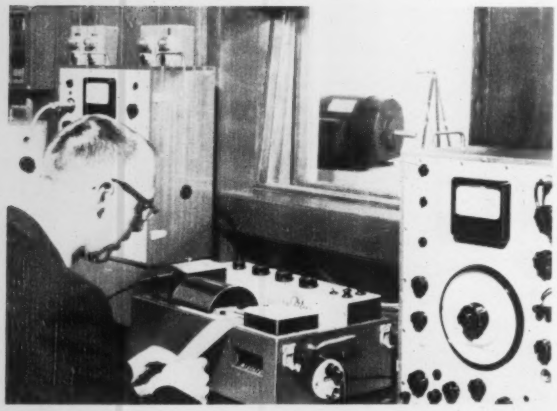
Allis-Chalmers "sound-coordinated" systems help achieve "quiet" in air-conditioning installations



RESEARCH — Two Allis-Chalmers single-suction ELECTRIFUGAL pumps installed in this midwestern research laboratory circulate chilled water for the air-conditioning system. Compact close-coupled design eliminates alignment problems . . . pump and motor share a single shaft.

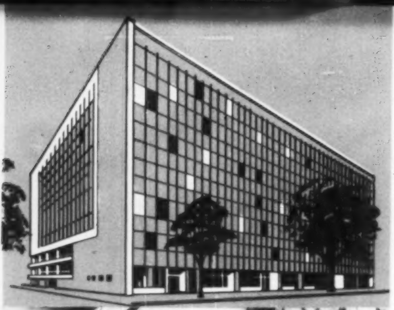


MEDICAL CENTER — A-C single-stage, double-suction pumps are in service at a Dallas medical center. One unit handles condenser water; the others circulate chilled water. Horizontally split casings, separate removable bearing housings simplify maintenance.

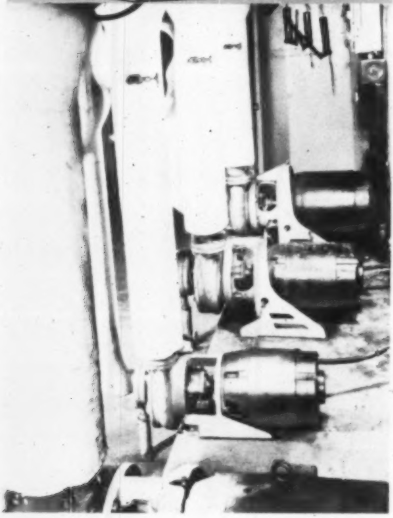


New sound laboratory at Allis-Chalmers — Smooth-running Allis-Chalmers pumps and motors "speak" with a whisper. The secret of their silent efficiency is *special care* in manufacturing and testing. Symbol of this care is the A-C sound-analysis laboratory where sensitive instruments can pinpoint the *exact source* of unwanted vibration. Combined with Allis-Chalmers years of experience in integrating pumps and motors for maximum efficiency, this new "sound-coordination" facility opens a new era of quiet in cooling. For reliable air-conditioning installations that pay off in fewer "callbacks," write for our new sound-analysis bulletin.

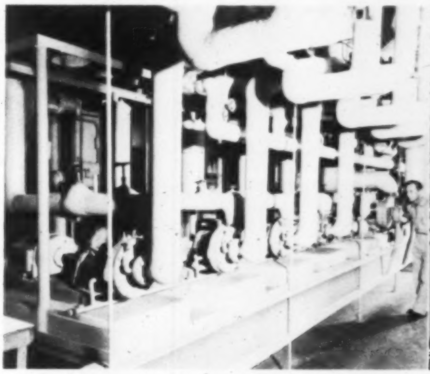
ALLIS-CHALMER

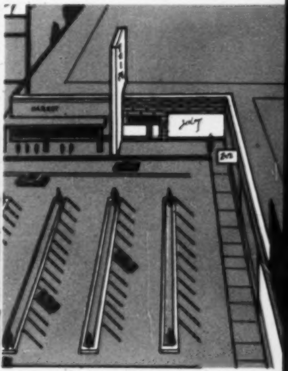


OFFICE BUILDING — Four ELECTRIFUGAL pumps on chilled water circulation in a Wisconsin office building. Easy maintenance features of these pumps keep downtime to a minimum. Stuffing box is readily accessible. Double shielded motor bearings protect against foreign matter, reduce possibility of over-greasing, are easily lubricated while in service.

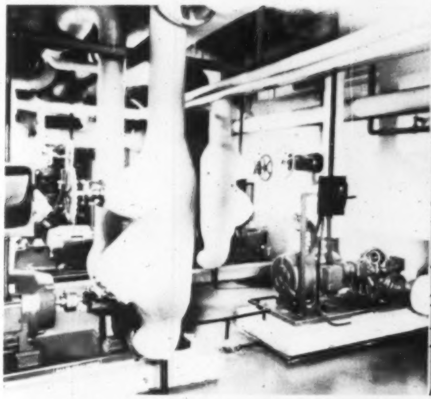


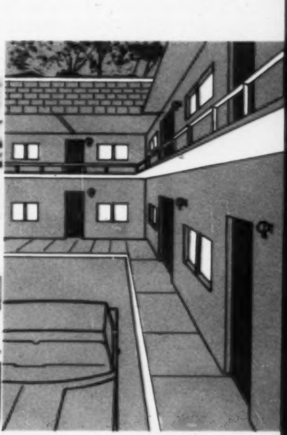
SHOPPING CENTER — These Allis-Chalmers frame mounted pumps circulate chilled water in a large southwest shopping center. Each is driven by an Allis-Chalmers open motor. Extra heavy pump shafts, with minimum overhang, reduce vibration and lengthen bearing and packing life.



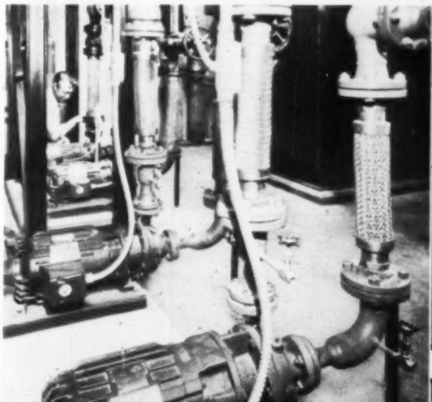


MOTEL — These double-suction pumps and motors are part of the air-conditioning installation in a new motor hotel. Like all Allis-Chalmers centrifugal pumps, these units incorporate renewable wearing rings and shaft sleeves to protect major parts from excessive wear.





SCHOOL — Six ELECTRI-CAND pumps provide positive protection against leakage in the completely sealed hot water system of this junior high school. Sealless design assures operation for long periods of time with minimum maintenance . . . no leakage.



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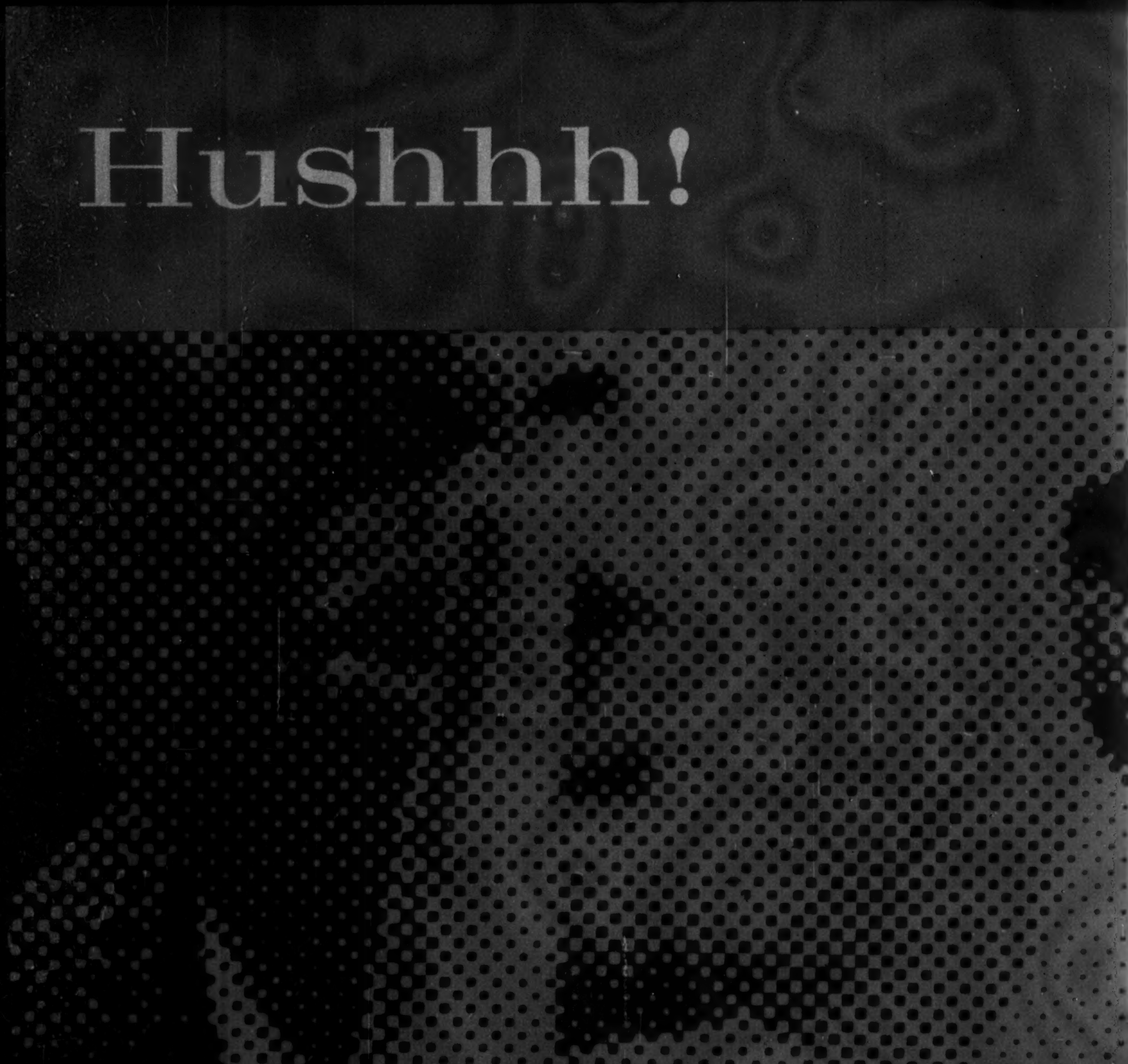
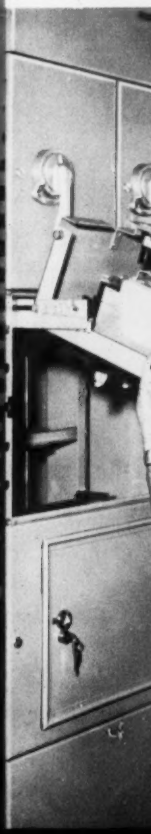
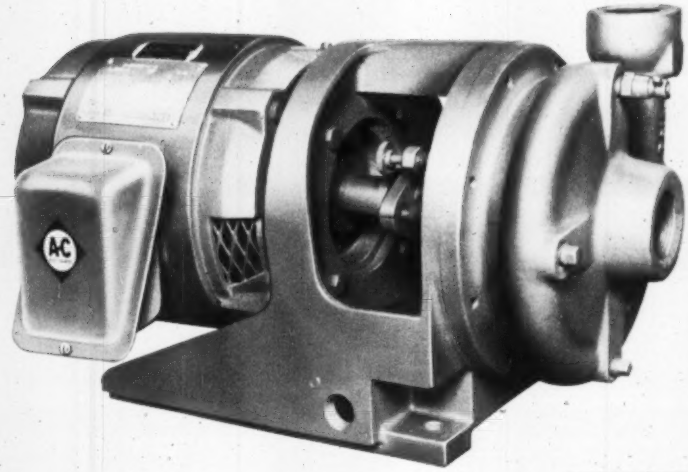

Hushhh!
...new era of "quiet" in cooling—from Allis-Chalmers

Fo

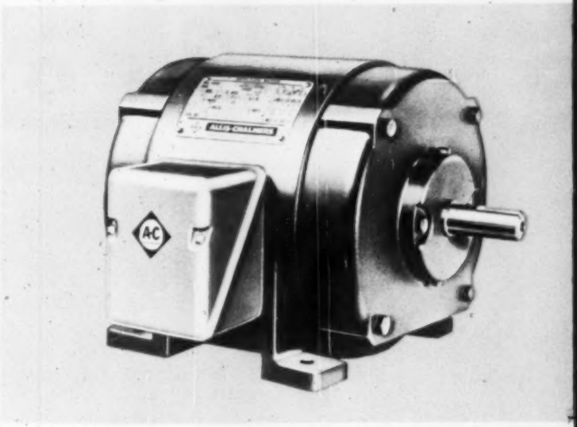


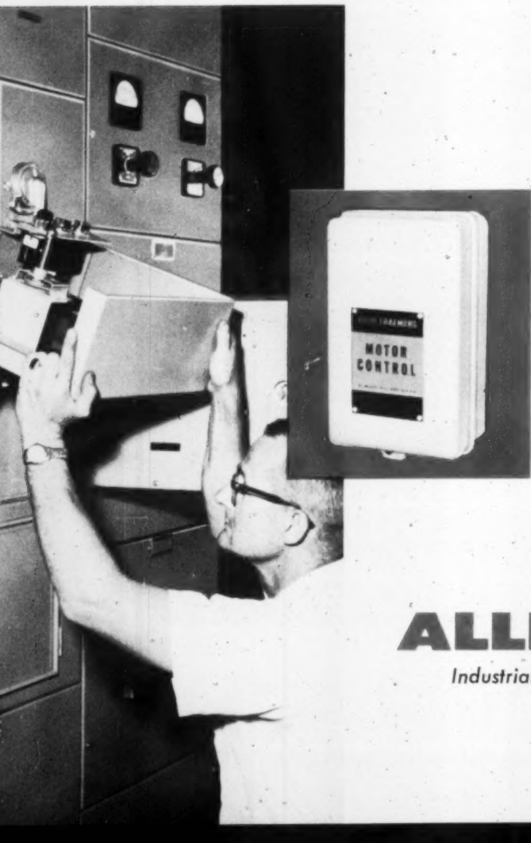
or quiet air-conditioning installations, specify...



READILY INSTALLED, EASILY SERVICED PUMPS — Pumps in the comprehensive Allis-Chalmers line include types and sizes for every air-conditioning application. Integration of pumps and motors simplifies installation. Single-suction impellers are of the enclosed type, and are hydraulically balanced. Replaceable wearing parts contribute to reduced maintenance costs. For maximum installation flexibility, discharge nozzles can be rotated to at least four different positions. For assistance in selecting the proper pump for your application, you are invited to consult Allis-Chalmers application engineers.

OPEN MOTORS THAT RESIST MOISTURE — For air-conditioning applications involving high humidity levels or occasional flooding, you'll find a low-cost solution in SUPER-SEAL open motors. Special POXEAL or SILCO-FLEX insulations — developed by Allis-Chalmers — render these motors impervious to moisture and contaminants. And, should flooding occur, no costly bake-out period is required. A quick "hosing" is sufficient to clean the motor and restore it to service. For complete information on remarkable SUPER-SEAL motors, write for Bulletin 05-51B9040B.





CONTROL CENTERS CUT COSTS: You save space, simplify wiring, and reduce inspection and maintenance expenses with new Allis-Chalmers low voltage motor control centers. Plug-in terminal blocks and drawout construction cut inspection time by making it quick and easy to withdraw or remove control units. Pushbuttons and pilot lights are mounted on the removable frames to eliminate failures common with hinged wiring. Special connectors make it impossible for bus connections to loosen. Extra heavy bus bracing makes additional bracing unnecessary when you add capacity.

The complete line of Allis-Chalmers low voltage motor starters and accessories, and the new SPACEMAKER high voltage motor controller, incorporate equally advanced design features. Features that make these units especially easy to install, inspect, and maintain.

Electrifugal, Electri-Cand, Super-Seal, Poxeal, Silco-Flex and SpaceMaker are Allis-Chalmers trademarks.

ALLIS-CHALMERS

Industrial Equipment Division • Milwaukee 1, Wisconsin

A-1475
52B9961

VIRGINIA Chemicals

REFRIGERATION BULLETIN

Facts about water system maintenance

ANSWERS TO COMMON WATER TREATMENT PROBLEMS

Water obtained from natural sources is not really pure. It contains foreign matter in varying forms and amounts. This may be present as suspended solids or solids and gases in solution. The conventional dividing line between soft and hard water is 200 ppm (parts per million) of these impurities—the higher the ppm, the harder the water.

It is these substances that cause scale buildup. In cooling with water, evaporation takes place, causing increasingly higher concentration of the impurities. Eventually the solid matter drops out as a sludge or deposits on the metal surfaces, forming scale.

How to identify problem scales

Prepare a dilute solution of solid or liquid scale remover in a glass jar or bottle (1 tsp. of solid scale remover per ½ pt.—1 tbsp. per ½ pt. of liquid). Chip small pieces of scale from the unit, drop them in the solution and observe the action.

Magnesium or Calcium Carbonate Scale
Usually of light color. Will bubble vigorously in the solution.

Iron Scale
Usually a brown or reddish color. Bubbles slightly, but an oily ring may appear on solution surface.

Sulfate and Silica Scale
Can be any color. Usually is extra hard and flinty. Little or no bubbling in solution. Scale of high silica content may have a glossy surface.

How to remove them

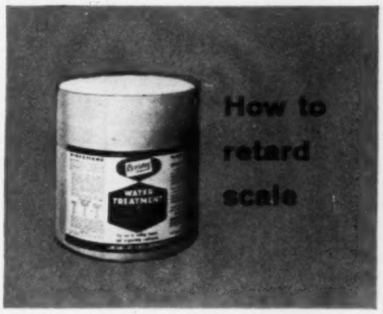
Magnesium or Calcium Carbonate Scale
Can be easily removed with either liquid or solid scale remover.

Iron Scale
Requires liquid scale remover. Use 4 gal. per 15 gal. of sump water. Stop fan to let water temperature rise to 100-110F but not over 120F. Clean at this temperature for best results. About 4 hr. needed.

Oily Scale
First add 1 box of Dash detergent per 100 gal. of system water. Run 15-20 min. Be sure foaming is not excessive. Leave the Dash in the solution and add recommended dosage of solid (5# per 10 gal. of water) or liquid (1 gal. per 15 gal. of water) scale remover.

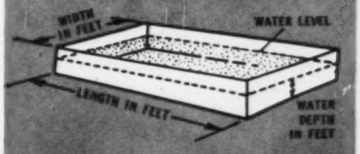
Sulfate Scale
Add 1 lb. of baking soda per gallon of sump water. Circulate for 8-12 hr. Then drain, rinse and refill system. Add liquid scale remover—4 gal. per 15 gal. of water. Circulate 2-4 hr., using test papers regularly to check cleaning strength.

Note: If any of these treatments fails, a second attempt should be made. A second failure would indicate the scale can be removed only by harsh chemical treatment or mechanical means.



"Virginia" Scale & Corrosion Inhibitor
Glassy polyphosphate crystals, provides slow, controlled solubility. No mechanical feeding devices are needed. Inhibitor holds scale-forming solids in suspension or solution. Deposits thin protective film on metal to stop oxidation. Has neutralizing effect on weak acids.

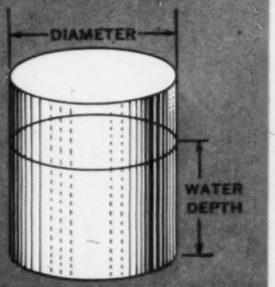
HOW TO CALCULATE AMOUNT OF WATER IN A SYSTEM



RECTANGULAR TANK OR SUMP

Measure (in feet) the length, width and water depth. Then length x width x water depth x 7.5 equals gallons of water.
EXAMPLE: If sump is 5 ft. long, 4 ft. wide, and water is .5 ft. deep, the calculation is as follows:

5 x 4 x .5 x 7.5=75 gal.



ROUND TANK

Measure diameter of tank and depth of water in feet. Then diameter squared x water depth x 6 equals gallons of water.

EXAMPLE: Tank has diameter of 3 ft. and water is 3 ft. deep

9 x 3 x 6=162 gal.

For more helpful information on water treatment problems and the chemicals needed for dealing with them, send us the coupon below.

WATER COOLING PROBLEMS
how to CORRECT them

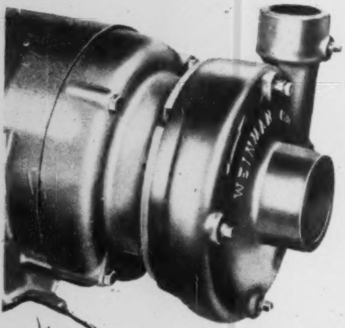
Refrigeration Division, VIRGINIA SMELTING COMPANY
508 Jefferson St., West Norfolk, Va.

Send me a copy of your booklet "Water Cooling Problems—How to Correct Them"

Name________________ Title__________

Company________________________

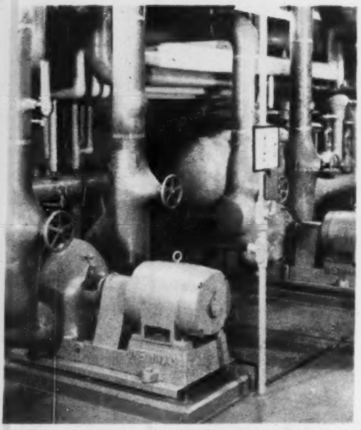
Address________________________



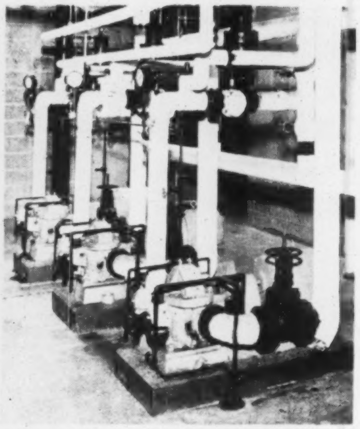
Effective heating and cooling depends on a constant supply of water . . . in the right quantities . . . at the right temperature. That's why Weinman Pumps are specified as an integral part of the heating and air conditioning systems designed into today's buildings. Engineers and architects, alike, know Weinman's line of centrifugal pumps is their best assurance of pumping performance to meet precise requirements. Maintenance engineers, too, prefer Weinman pumps for rugged durability, easy maintenance and dependable, 'round-the-clock service.

Across the nation...

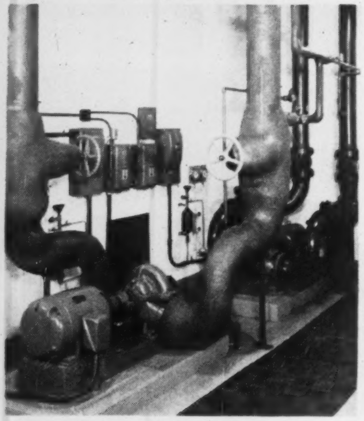
WEINMAN IS THE STANDARD IN PUMPING PERFORMANCE



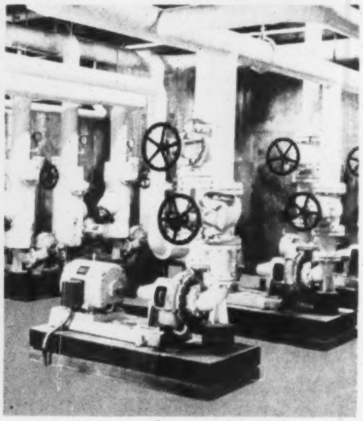
IN OHIO
The world's largest electrically powered air source heat pump, at the Columbus and Southern Ohio Electric Company, depends on 12 Weinman Pumps for circulating all liquids through the system.



IN PENNSYLVANIA
A battery of Weinman Pumps delivers water from a central heating plant to the 30 building complex of the new state-operated Institution for Defective Delinquents in Luzerne County.



IN MISSOURI
Seven Weinman Pumps move hot and chilled water through the air conditioning system; remove sewage and deliver water to a decorative pool and waterfall at Old American Insurance Company's new Kansas City headquarters.



IN COLORADO
Denver's First National Bank Building gets efficient handling of condenser and chilled water for its air conditioning system with an installation of 6 Weinman Pumps.

Whatever your pumping need . . . there's a Weinman Pump to fit your precise specifications. For qualified recommendations consult your Weinman Specialist . . . he's in the Yellow Pages . . . or write direct.

THE **WEINMAN PUMP** MFG. CO.
290 SPRUCE STREET COLUMBUS 15, OHIO
CENTRIFUGAL SPECIALISTS

For reliability, low cost, good looks specify Armstrong Armaflex 22

Armaflex 22 is a foamed plastic pipe insulation that stops condensation on cold lines and saves heat on hot lines to 220° F. An Armaflex job is reliable, low cost, and neat.

Reliable—The proper thickness of Armaflex 22 stops condensation permanently. Its closed-cell structure forms a vapor barrier all the way through—requires no finish or jacket indoors.

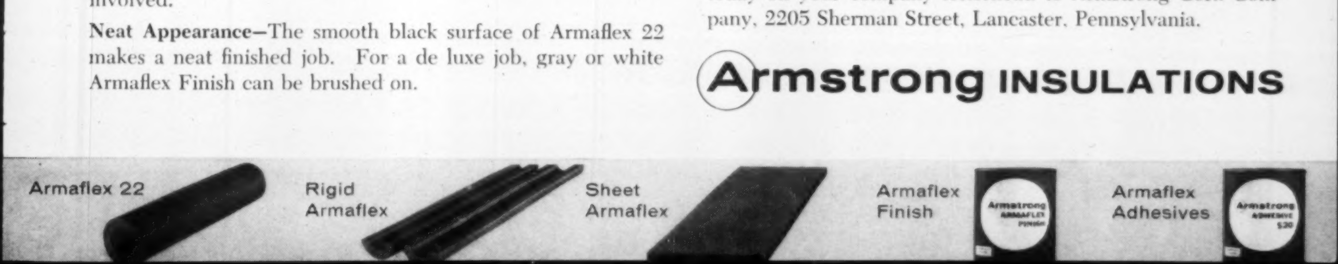
Low Cost—Armaflex goes on fast—cuts labor costs. All the workmen do is apply the covering and seal the joints with Armstrong 520 Adhesive. Fitting covers are quickly made from miter-cut pieces and applied the same way. Many contractors report savings of 50%, particularly where many fittings are involved.

Neat Appearance—The smooth black surface of Armaflex 22 makes a neat finished job. For a de luxe job, gray or white Armaflex Finish can be brushed on.

Armaflex 22 is one of a complete line of Armaflex products for insulation jobs from below zero to 220° F. Also included are Rigid Armaflex for use at pipe hangers and other places where compression is a problem; Armaflex Sheet for tanks, vessels, large pipes, and fittings; Armaflex Finish for outdoor applications and an especially attractive appearance indoors or out; plus the special Armstrong adhesives that insure a neat and reliable job.

For your copy of the Armaflex Specifier Portfolio, which contains complete data on the products in the complete Armaflex line, plus detailed specifications on their application, write today on your company letterhead to Armstrong Cork Company, 2205 Sherman Street, Lancaster, Pennsylvania.

Armstrong INSULATIONS



IN
A
MANHOLE
OR
ON A
MIXER

Wagner® "Stand-up" motors pack plenty of power

Here's plenty of power for equipment requiring normal thrust vertically mounted motors. Wagner® Vertical Solid Shaft Motors provide power without problems for your pumps, mixers, agitators, axial fans, centrifuges, presses . . . anywhere you need a vertical motor drive with plenty of stamina.

Wagner Vertical Solid Shaft Motors are end-mounted, squirrel-cage type with a NEMA Type "P" base that is precision-machined to mate with equipment. Smooth running under cyclic loads, they won't labor or stall . . . conform with NEMA Design B motor requirements in all respects. Their cast iron construction is simple and rugged . . . stands off corrosion . . . stands up to rough, tough treatment. Here are motors that are designed to give you economical, maintenance-free service the year 'round, indoors or out.

Wagner "Stand-up" Motors are available in ratings of 1 hp and larger with nominal full load speeds of 3500, 1750, 1160, or 870 rpm, and can be supplied with a completely dripproof enclosure, a standard totally enclosed fan-cooled enclosure, or an explosion-proof TEFC enclosure. Whatever the horsepower, whatever the enclosure, whatever the application, one thing is sure . . . these compact, power packages get the job done. For all the reasons why, check with the Wagner Sales Engineer in the Wagner branch nearest you, or write us for Bulletin MU-249.

Branches and Distributors in all Principal Cities

Wagner Electric Corporation
6370 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.

Wagner Vertical Solid Shaft Motors provide the power for Smith & Loveless sewage pumping stations.

WM61-8

Propeller Fans
Ventilating Fans
Roof Ventilators
...a galaxy of products to solve your air handling problems...
Industrial Fans
Propeller Unit Heaters
Centrifugal Unit Heaters
General Purpose Fans
nyb

THE NEW YORK BLOWER COMPANY

Sales offices: 3149 South Shields Avenue • Chicago 16

HARDWORKING CENTURY MOTORS MOVE AIR AND WATER FOR CONTINUOUS PROCESS

Air and steam condensate vital to continuous production of wall board are kept moving dependably—and the plant is kept running—by fans and pumps powered by Century integral horsepower motors.

Take the exhaust fan motor at the left, for example. These 75-hp, 1170-rpm, squirrel-cage motors power fans that pull exhaust air from a pneumatic conveying system through Cottrell precipitators. The air conveys gypsum dust in process. The air must be pulled through the precipitators for cleaning before being exhausted to the atmosphere. This round-the-clock dust control is necessary to prevent harmful contamination of the plant atmosphere as well as the surrounding community.

The two 30-hp, 1750-rpm totally-enclosed fan-cooled motors above operate boiler condensate return pumps. The motors are in hot pits. Because the pits are under a plant roadway, everything in them becomes laden with dirt and grease that drops off of trucks passing over head.

Process air for conveying gypsum dust and process condensate are both required continuously to keep this plant operating. These rugged, well-protected Century motors keep these vital process elements flowing.

Other Century motors at work in this plant drive ventilating fans, conveyor lines, crushers, pulverizers, and dust flues. Each provides power for a different job in a different place.

Each of these Century motors was carefully selected for its particular job by plant engineers working closely with Century motor specialists. Speed, torque, voltage, power factor, starting current, load requirements, and environmental conditions were carefully evaluated before selecting horsepower, motor type, and enclosure.

Ask your Century representative (he's a full-time motor specialist) for assistance with your motor application problems. You'll find that he knows his business, and can help you in yours.

CENTURY ELECTRIC COMPANY

St. Louis 66, Missouri *Offices and Stock Points in Principal Cities*

61-6

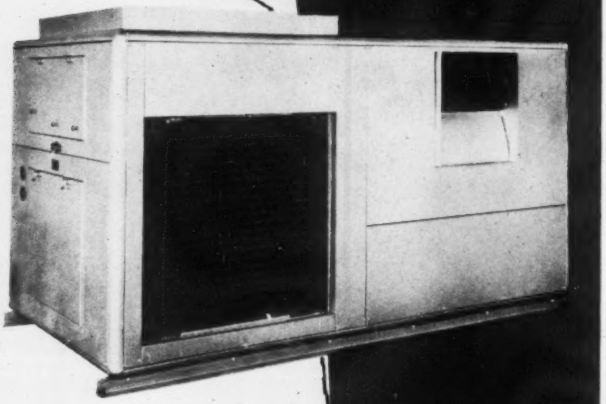
[illegible] NEWEST ADDITION TO THE INDUSTRY'S LEADING SELF-CONTAINED LINE

Governair

COMPLETELY SELF-CONTAINED

AIR COOLED

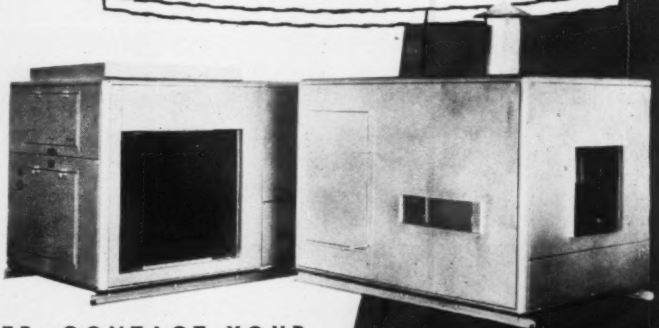
PACKAGE UNIT TYPE SCAC



GOVERNAIR'S SCAC is available in six basic models from 10 through 40 ton capacities. Typical GOVERNAIR flexibility has been maintained with a choice of 4, 5, or 6 row cooling coils offered to meet all capacity requirements. Roof mounting has been considered in the Low-Silhouette arrangement.

The basic one-piece cooling unit is housed in a rugged weatherized cabinet and mounted on rails. It is completely wired, charged and tested at the factory. Demountable and remote arrangements are available, and accessories include choice of filters, face and by-pass dampers, reduced voltage starters, Low Ambient Control, and the Gas Fired Furnace Section.

YEAR-'ROUND AIR CONDITIONING is accomplished by the use of the gas-fired furnace section. This accessory consists of a complete and unaltered gas-fired duct furnace housed in a Weatherized Cabinet with an integral by-pass damper arrangement. Refrigerated air may completely by-pass the furnace, while any desired amount of air is diverted through the furnace during the heating cycle.



FOR AN INFORMATIVE FOLDER, CONTACT YOUR LOCAL GOVERNAIR REPRESENTATIVE OR WRITE

GOVERNAIR

4840 N. SEWELL
OKLAHOMA CITY

When it's time for replacement . . .

14
125WSP
150WOG
OIC
14
125WSP
150WOG
OIC

. . . more and more plants switch to OIC valves!

There's no magic to it! Engineers responsible for power and production look to OIC for longer continuous service and lower maintenance costs. These men have found by experience OIC iron and bronze valves (cast and forged steel and ductile iron too) are built to resist the three enemies of fluid handling . . . erosion, galling and corrosion. Trim variations are available to meet your specific requirements including special alloys for highly corrosive and severe pressure-temperature operating conditions.

OIC offers a complete line of gates, globes, angles and checks. Large stocks are carried throughout the United States by a fine distributor organization which stands ready to help you with all your valve problems. Our engineers are ready at a moment's notice to study particularly tough problems and submit recommendations. Get acquainted with your OIC distributor and learn how he can help you cut maintenance and replacement costs.

Better valves and better service from OIC distributors

INDUSTRIAL DISTRIBUTORS
SERVING INDUSTRY ECONOMICALLY
THE RIGHT HAND OF PRODUCTION

OIC VALVES

**BRONZE, IRON, FORGED
STEEL, CAST STEEL AND
DUCTILE IRON VALVES**

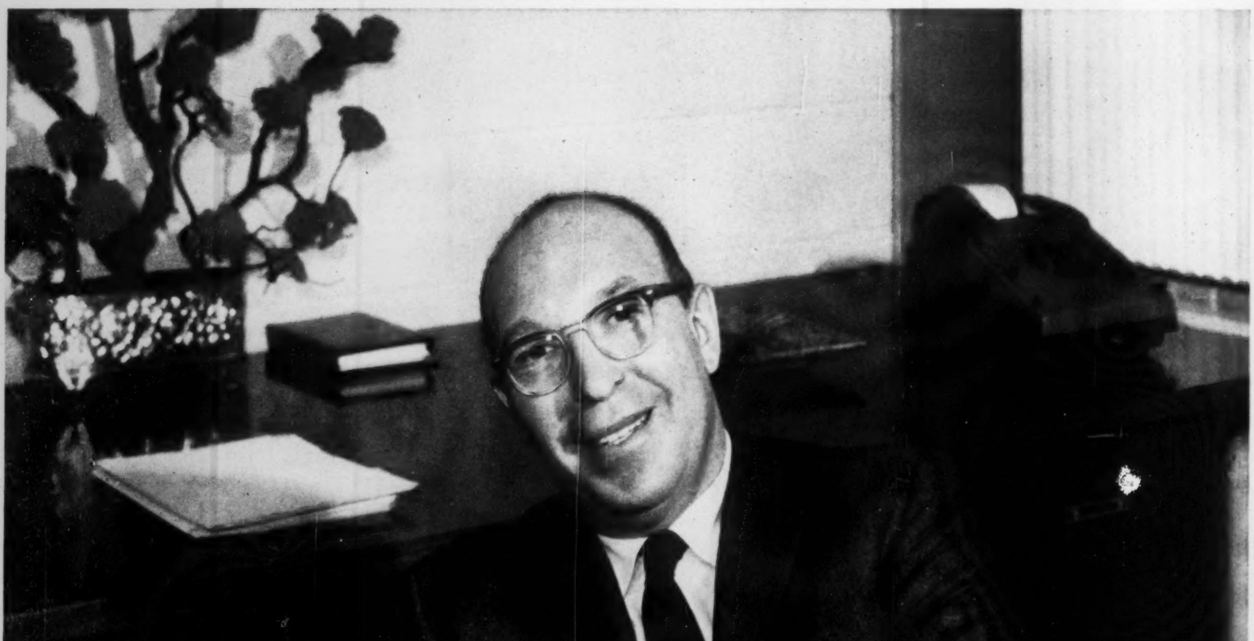
10220-OIC

THE OHIO INJECTOR COMPANY
235 Main Street, Wadsworth, Ohio
Please send more information about Iron ( )
Bronze ( ) Steel ( ) Ductile Iron ( ) Valves.

Name____________________
Company____________________
Street____________________
City__________ Zone_____ State________

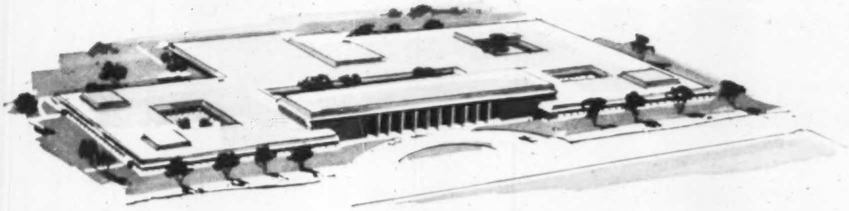
Edward Ross, President, Economy Plumbing Co., Mechanical Contractor for the Pure Oil Building, Palatine, Illinois, says:

"Pure Oil was an elaborate Honeywell helped



Mr. Edward Ross of Economy Plumbing. Mr. Ross found the Honeywell Selectographic Data-Center of great help in analyzing the performance of Pure Oil's temperature control systems.

job, but
us over the rough spots"



ARCHITECTS: *Perkins & Will, Chicago*
CONSULTING ENGINEER: *E. R. Gritschke Assoc., Chicago*
MECHANICAL CONTRACTOR: *Economy Plumbing Co., Niles, Ill.*

At Pure Oil's new home, individual temperature control in over 400 rooms is maintained and constantly supervised by a Honeywell Selectographic DataCenter*.

"This new Pure Oil Building has one of the most intricate temperature control systems we've ever seen," says Mr. Ross. "In fact, there are more individual controls than in 99% of the systems built today." Mr. Ross adds: "We counted on Honeywell for accurate scheduling and over-all supervision of the installation—and they came through! Honeywell always had enough engineers and technicians on the job to keep everything rolling smoothly. It's very reassuring to know Honeywell's on your team."

The Honeywell Selectographic DataCenter controls temperatures for the entire Pure Oil Building. It also includes control over a building-wide security system and fire alarm system. Because the fire alarm system is hooked up to the local fire department, one of Honeywell's many jobs was to indoctrinate the Palatine Fire Department on the Selectographic and the new fire alarm system.

With 76 years experience in temperature control you can depend on Honeywell quality and service. Fine controls, accurate specifications, prompt delivery and expertly supervised installations are assured with Honeywell on your team. And only Honeywell designs and manufactures all three types of control systems—pneumatic, electric and electronic. For further information, call your nearby Honeywell Office. Or write Honeywell, Dept. AC-5-126, Minneapolis 8, Minn.

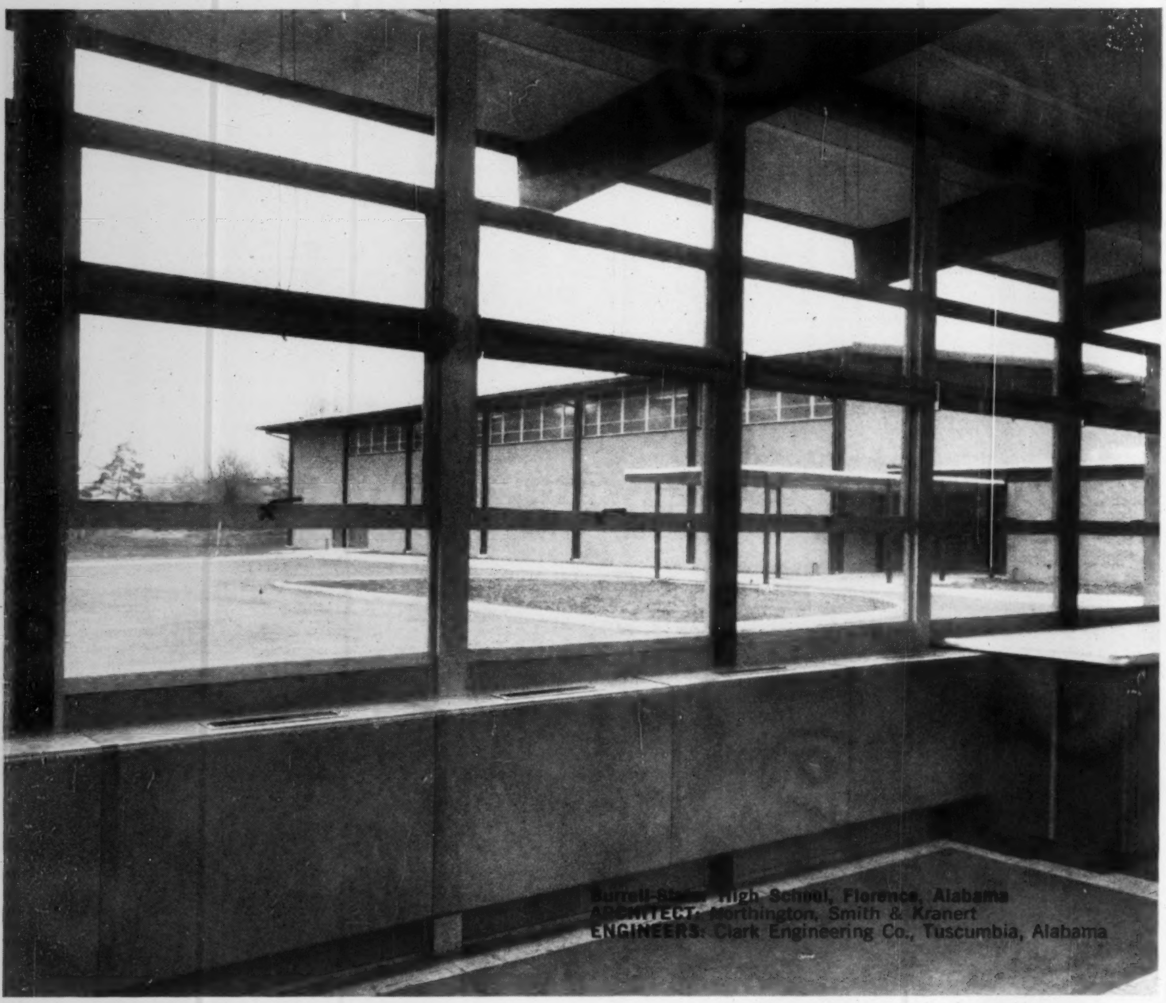
*Trademark

Fred Heiden, Utility Operator for the Pure Oil Building, seated at the Selectographic DataCenter.

Honeywell

H HONEYWELL First in Control
SINCE 1885

HONEYWELL INTERNATIONAL
Sales and service offices in all principal cities of the world. Manufacturing in the United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.



Burrell-Slater High School, Florence, Alabama
ARCHITECT: Northington, Smith & Kranert
ENGINEERS: Clark Engineering Co., Tuscumbia, Alabama

Total installed cost only 97.8¢ per sq. ft. for NORMAN SCHOOLROOM HEATING AND VENTILATING SYSTEMS in 32-room school

Saving money on first cost is only one of the reasons why school architects, engineers and school administrators are turning to gas-fired Norman Schoolroom Heating and Ventilating Systems. With building costs still rising, Norman individual room-by-room systems are budget-savers. This modern 32-room school is another cost-cutting example.

Nineteen classrooms, gymnasium, auditorium and stage, dining room, library and other areas are efficiently and comfortably heated and ventilated. Yet the building has no pipe tunnels or central heater room . . . no costly network of connecting pipes or ducts.

But most important is the ideal study environment maintained through individual room comfort. Each Norman system evenly distributes fresh outside air blended with recirculated room air *when needed* but conserves fuel during unoccupied periods.

Looking ahead, you can add any number of rooms without touching the existing Norman systems. Air conditioning may be included at time of installation or in the future.

Want more facts and figures? Send for comprehensive manual on Norman HVS Horizontal or Inn-A-Wal Counter Flow models.

Norman® **PRODUCTS COMPANY • 1156 Chesapeake Ave., Columbus 12, Ohio**

In the RUSH months coming up

INSIST ON

genetron®

SUPER-DRY REFRIGERANTS

The remarkable dryness and purity of "Genetron" Refrigerants always pay off in dependable, trouble-free performance. That's why "Genetron" Super-Dry Refrigerants are accepted, approved, and *preferred* both for original equipment and replacement charging.

"Genetron" fluorinated hydrocarbon refrigerants are *right*—and they are *ready*. Your "Genetron" wholesaler has them in stock, and is prepared to supply your needs . . . in a hurry! Ask him, too, to show you the new "Genetron" Kit for field testing hermetic burnouts and the new pressurized "Genetron" 11 solvent cylinders for cleaning mildly contaminated systems after burnout.

genetron 11 CCl_3F ORANGE LABEL
TRICHLOROMONOFLUOROMETHANE

genetron 12 CCl_2F_2 WHITE LABEL
DICHLORODIFLUOROMETHANE

genetron 22 $CHClF_2$ GREEN LABEL
MONOCHLORODIFLUOROMETHANE

genetron 113 $C_2Cl_3F_3$ PURPLE LABEL
TRICHLOROTRIFLUOROETHANE

genetron 114 $C_2Cl_2F_4$ BLUE LABEL
DICHLOROTETRAFLUOROETHANE

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

Allied
Chemical

1 LEAK-PROOF CONNECTIONS

2 POSITIVE SEATING

3 CLEAN/OVER-ALL PROTECTION

4 EASY WRENCHING FAST MAKE-UP

1,000,000 × 4

More than one million Capitol forged steel unions are now in service . . . and not a single failure! Capitol has 4-way built-in insurance to give trouble-free service. Each one of the million has this exclusive combination of 4 engineering features:

(1) *Leak-proof connections* assured because Capitol unions have *more* threads, accurately cut and double-checked according to Army-Navy gauging practice. Both hand-tight and pressure-tight threads are checked, two operations instead of the one required for American Standard gauging. The extra threads mean on-the-job assurance of tight installations. (2) *Positive seating* because each union is individually pressure-tested. (3) *Clean/over-all protection*, each male and female part completely phosphate coated; each nut electro-zinc plated. (4) *Easy wrenching/faster make-up* because all three parts have a definite octagon shape.

You get all 4 important advantages at no extra cost when you specify CAPITOL forged steel unions . . . one of the full-line of Army-Navy gauged forged steel fittings. Now more than one million in service . . . and not a single failure.

CAPITOL MANUFACTURING CO.,

Division of Harsco Corporation, Columbus, Ohio.

CAPITOL

SPECIFY CAP FOR ALL FITTINGS

SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS

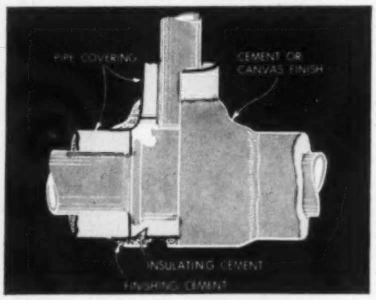
No. 4 in a series for your SPEC. FILE †

Suggested specifications for insulating VALVES and FITTINGS with G-B SNAP*ON® Glass Fiber PIPE INSULATION

DESCRIPTION

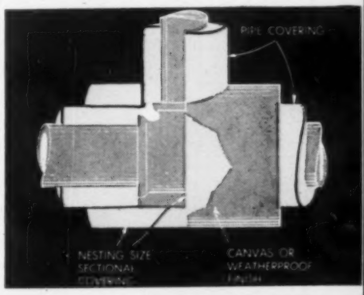
To cut the cost of insulating valves and fittings, try the insulation that is easily custom-cut with a pocket knife—G-B Snap*On, the original one-piece hinged pipe insulation molded entirely of fine glass fibers. Not only can workmen cut G-B Snap*On to fit around valves and fittings faster, but specifiers are assured of maximum insulation protection against heat loss or heat gain. In fact, G-B Snap*On offers "K" factors that are second to none among all general purpose pipe insulations. What's more, G-B Snap*On is lightweight, highly immune to damage, and as permanent as glass itself. It will not rot, corrode, mildew or otherwise deteriorate. And its all-glass-fiber construction makes it ideal for chilled and heated piping from sub-zero to 350° F. temperatures. G-B Snap*On is manufactured in thicknesses from ½" to 3" and is available in 3' lengths, plain or with a wide variety of facings and in 6' lengths, unfaced.

APPLICATION SPECIFICATIONS

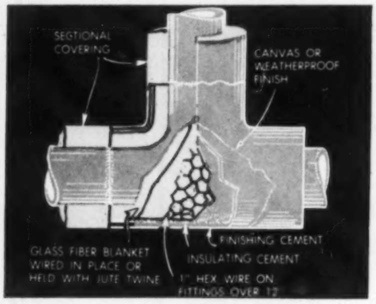

PIPE COVERING
CEMENT OR CANVAS FINISH
INSULATING CEMENT
FINISHING CEMENT

INSULATION OF PLUMBING AND HEATED PIPE FITTINGS ON PIPE SIZES UNDER 4" — INSULATING CEMENT Fittings on pipe sizes under 4" shall be insulated with insulating cement to the same thickness as the covering on the adjacent piping. In all cases, the cement shall be applied in two layers; the first layer allowed to dry before succeeding layer is applied. Final coat of cement shall be troweled to a smooth surface.

INSULATION OF PLUMBING AND HEATED PIPE FITTINGS FOR PIPE SIZES 4" AND LARGER—NESTING SIZE SECTIONAL COVERING Fittings on pipe sizes 4" and larger shall be insulated with nesting size sectional covering to the same thickness as the adjacent pipe insulation. The insulation shall be cut to fit in a neat workmanlike manner with all joints butted and held securely in place with copper-clad insulation staples. All joints shall be pointed up with insulating cement prior to receiving surface finish.

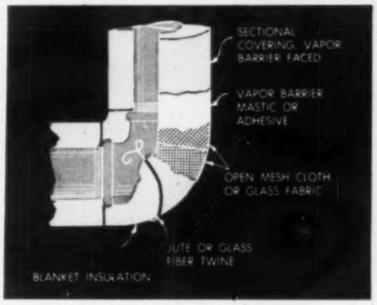

PIPE COVERING
NESTING SIZE SECTIONAL COVERING
CANVAS OR WEATHERPROOF FINISH

OPTIONAL BLANKET METHOD


SECTIONAL COVERING
CANVAS OR WEATHERPROOF FINISH
FINISHING CEMENT
INSULATING CEMENT
GLASS FIBER BLANKET WIRED IN PLACE OR HELD WITH JUTE TWINE
1" HEX WIRE ON FITTINGS OVER 12

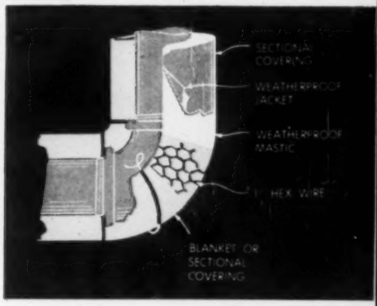
INSULATION OF PLUMBING AND HEATED PIPE FITTINGS ON PIPE SIZES 4" AND LARGER

The fittings on pipe sizes 4" and larger shall be insulated by firmly wrapping with a long textile-type glass fiber blanket insulation, held in place by wrapping with jute twine, to a thickness ½" less than the thickness of the adjacent pipe insulation. On pipe sizes larger than 6", a 1" galvanized hex mesh shall be wired in place over the insulation prior to receiving 2 coats of insulating cement.


SECTIONAL COVERING, VAPOR BARRIER FACED
VAPOR BARRIER MASTIC OR ADHESIVE
OPEN MESH CLOTH OR GLASS FABRIC
JUTE OR GLASS FIBER TWINE
BLANKET INSULATION

INSULATION OF COLD AND DUAL TEMPERATURE PIPE FITTINGS—CONCEALED PIPING

All cold piping valves, flanges and fittings shall be insulated with a long textile-type glass fiber blanket insulation wrapped firmly under compression (minimum 2 to 1) to the thickness of the adjoining pipe insulation and held in place by spiral windings of jute twine. A subsequent wrapping of open-mesh cloth or glass fabric tape shall be wrapped over the blanket insulation, overlapping the adjoining pipe insulation, and heavily coated with vapor barrier mastic.


SECTIONAL COVERING
WEATHERPROOF JACKET
WEATHERPROOF MASTIC
1" HEX WIRE
BLANKET OR SECTIONAL COVERING

WEATHERPROOFING — OUTDOOR PIPE FITTING INSULATION

All insulated fittings exposed to the weather shall be weatherproofed with two layers of asphalt mastic troweled to a smooth even finish. Fittings over 4" pipe size shall have a reinforcing membrane of open-mesh glass fabric or 1" galvanized hex wire applied after the first layer of mastic is applied. The second layer shall be applied after the first is dry. Mastic and reinforcing membrane shall overlap the weatherproof jacket of the adjacent pipe covering at least 3".

(CUT ALONG THIS LINE)

---

†A complete series of G-B Snap*On specifications has appeared in this publication in the past months. If you missed any of them and would like to have a complete set of G-B Snap*On specifications, simply write:

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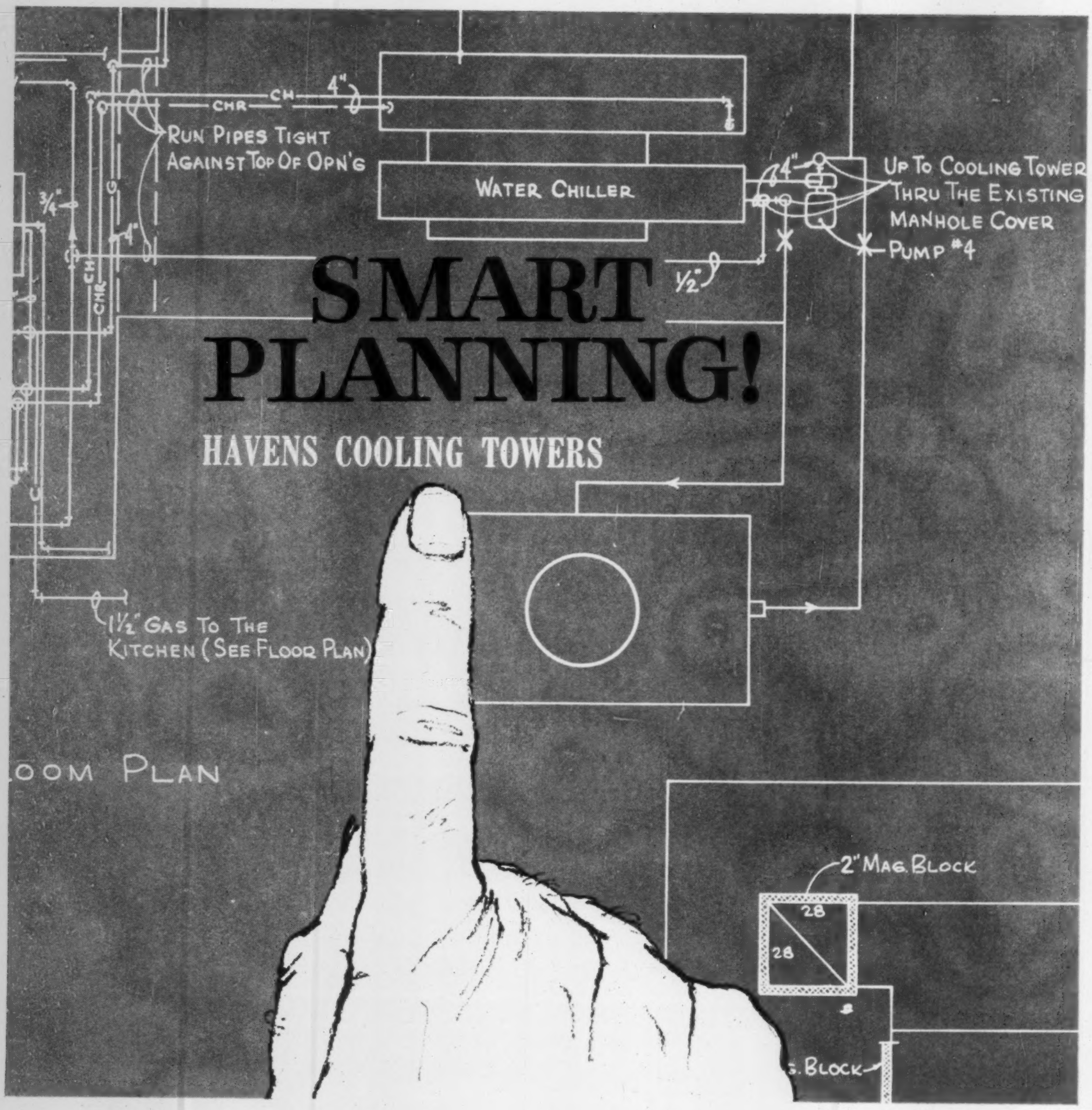
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CH
4"
RUN PIPES TIGHT AGAINST TOP OF OPN'G
3/4"
CH
CHR
4"
WATER CHILLER
4"
UP TO COOLING TOWER THRU THE EXISTING MANHOLE COVER
PUMP #4
1/2"
1 1/2" GAS TO THE KITCHEN (SEE FLOOR PLAN)
OOM PLAN
2" MAG. BLOCK
28
28
G. BLOCK

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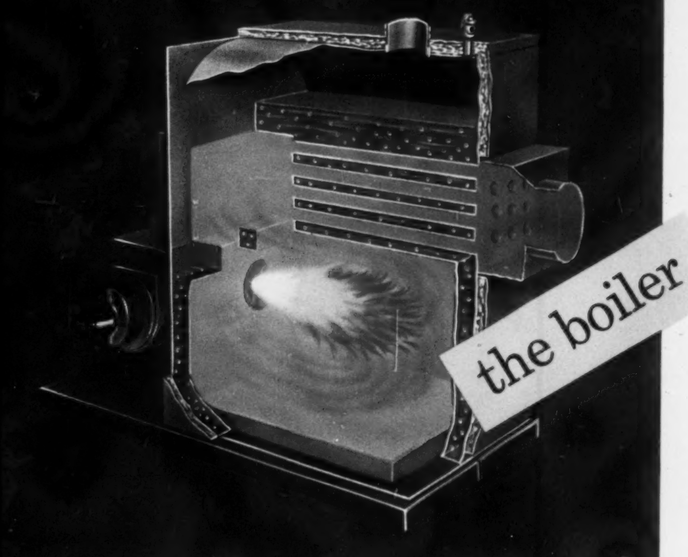
combustion
PETRO
PAC
economy
package



the package

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provides exceptionally
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A unique, new d
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The PetroPac pac
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1. THE PROBLEM—elimina
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3. THE PROBLEM—divided
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oPac generator e heat per dollar than ors

s hot combustion gases, travels first
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front of the furnace. The result is that
closed in an envelope of hot gases
bustion better than a refractory cham-
ses enable 100% combustion to take
cles are completely consumed within
no unburned material to be carried
o be cooled and deposited as soot.
-pass area the water legs and a water
above a heat reflecting hearth absorb
e soot-free hot gases, with fuel totally
ke a third and final pass through the
re is only one tube pass the pressure
The two-pass furnace arrangement
ally generous combustion volume
t of primary heating surface exposed
eat. Radiant heat transfer to the primary surface is far more effective than convective heat transfer to secondary heating surfaces. The greater proportion of radiant heat transfer surface in the PetroPac design, therefore, provides more capacity per square foot of heating surface. This results in higher capacities and lower stack temperatures, because there is less heat remaining to be absorbed in the tubes.

Another PetroPac advantage is this: since initial combustion is supported by an envelope of hot gases the combustion chamber does not require sidewall refractory. Furnace heat is absorbed directly into the water legs, with an enormous gain in heat transfer.

Standby loss, the greatest fuel waster of all, is reduced to almost nothing. This is due in part to the sealed combustion feature which prevents cold air infiltration, and partly to the elimination of boiler refractory with its large volume of stored heat which is ordinarily dissipated at relatively low temperatures during burner "off" periods.

Cuts service costs. Total combustion cuts service costs drastically. Since there is no sidewall refractory, costly fire-box maintenance is also eliminated.

v design for iring of oil, or gas, or nation

ed combustion — no chimney,
new PetroPac burner operates under
firebox pressure in a sealed combus-
fore, no chimney draft is needed—
erates equally well with a chimney.

tio — perfect combustion. All the
total combustion are controlled with
oth fuel and air are metered with
The combustion chamber receives
air supply through the burner firing
not intrude through firebox vents or
s, nor is the combustion process
es of natural draft. The exact amount of air insures an optimum fuel-air ratio for total combustion. The PetroPac flame starts clean and *stays* clean.

No pulsation—steady, even flame. PetroPac's unique burner head eliminates flame pulsation. A throbbing, puffing fire is not only a first-rate nuisance but a soot-producer and a waster of fuel. The PetroPac burner starts evenly and burns steadily.

Unique design — high efficiency firing. The new design PetroPac draft tube and firing head keeps the flame constant regardless of individual pressure and draft requirements.

The oil phase of the burner achieves maximum efficiency because of the precise volume of air which is released just ahead of the oil feed nozzle.

Multiple jets are used in the gas phase of the burner. As with oil, gas is discharged directly into the air stream but behind a vaned burner head. This provides a uniform mixture of air and gas a split second before both enter the combustion chamber.

package gets results . . here are the problems, and the PetroPac results

minate need for high chim-
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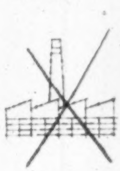
esign a forced draft, sealed
oiler package.

PetroPac makes natural
essary. Exhaust vent can be
can be as much as a third
an a natural draft stack.



minate errors of wiring and
assembly

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troPac package requires no
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boiler and burner can be
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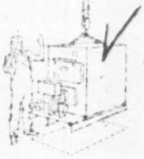
nage or vandalism during



vided responsibility among
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limit responsibility to *one*

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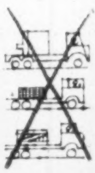
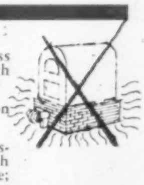


4. THE PROBLEM — elimination of high heat loss through refractory base, and standby loss through chimney.

   THE SOLUTION—design a sealed combustion boiler.

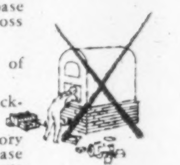
   THE RESULT—New PetroPac sealed combustion design prevents leakage of cold air through access doors, vents and around refractory base; eliminates heat retaining, heat wasting brick base and firebox refractory, and makes 'standby' loss negligible.



5. THE PROBLEM—stop periodic breakdown of maintenance-prone refractory sidewalls.

   THE SOLUTION—completely eliminate buckling, spalling refractory sidewalls.

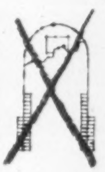
   THE RESULT—PetroPac needs no refractory sidewalls—only an insulating refractory base which is virtually maintenance-free, and reflects radiant heat against the heat absorbing crown sheet.



6. THE PROBLEM—modern commercial and industrial construction often demands space-saving, low ceiling boiler rooms.

   THE SOLUTION—design a boiler without a high refractory-lined base.

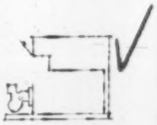
   THE RESULT—PetroPac has reduced the height of the boiler base from three feet or more to only *three inches* by eliminating a refractory-lined base.



7. THE PROBLEM—how to provide easy access to tubes and combustion chamber.

   THE SOLUTION—a boiler design that not only gives quick access to the tube bank but also provides space for entering the furnace itself.

   THE RESULT—a boiler that has an opening behind the tube cleanout door, giving access to the furnace. Entire flame area can be easily seen through glass observation door without breaking seal.



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- ☐ Information on models and prices.
- ☐ I am interested in a dealer franchise.

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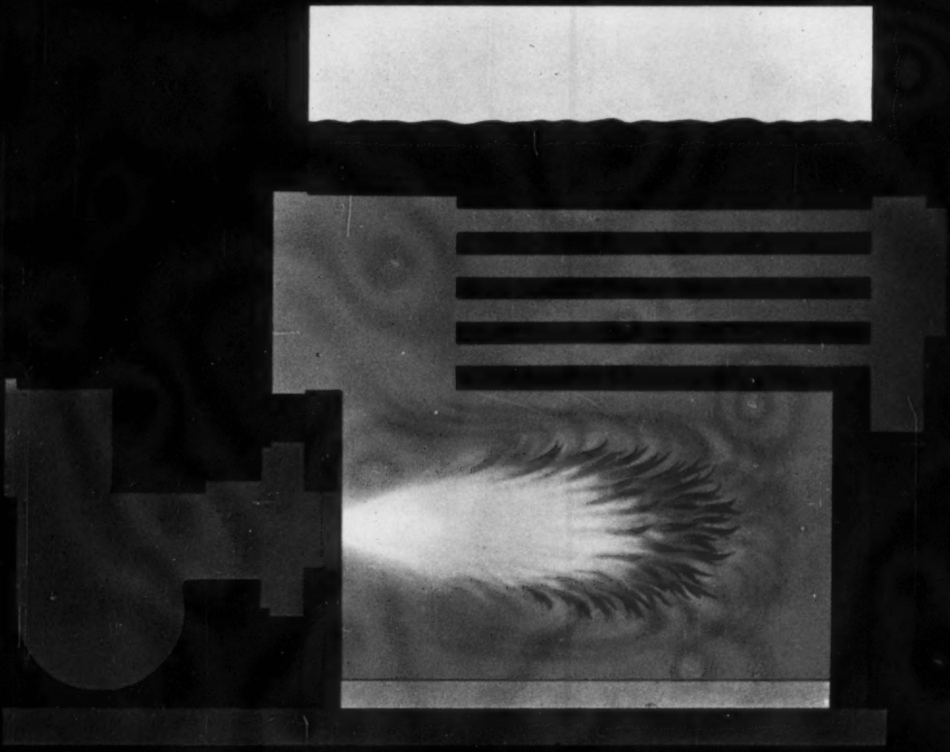


a compact 3-pass package with a big 2-pass furnace

Complete, *total* combustion — before products of combustion enter the tubes — is the key to the remarkable economy of this advanced new package generator

FOR GAS, OIL OR DUAL FUEL

specifications

RATINGS

UNIT NUMBER		PPF 324	PPF 396	PPF 504	PPF 648	PPF 792	PPF 1008	PPF 1260	PPF 1512	PPF 1800	PPF 2100	PPF 2400
Certified Output Steam or Water	MBTU/HR	324	396	504	648	792	1008	1260	1512	1800	Available Shortly	Available Shortly
Heating Surface	SQ. FT.	41	53	65	88	106	153	177	206	236		
Firing Rate No. 2 Oil	GPH	3.0	3.5	4.5	5.8	7.1	9.0	11.3	13.5	16.1		
	Gas MBTU/HR	432	495	630	810	990	1260	1575	1890	2250		
Burner Motor H. P.	GAS	1/4	1/4	1/4	1/4	1/2	1/2	1/2	1/2	1-1/2		
	OIL	1/4	1/4	1/4	1/4	1/2	1/2	3/4	3/4	1-1/2		
	GAS-OIL	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1-1/2		

Standard equipment

Steel firebox boiler mounted on refractory lined platform base. The steel jacket is lined with insulation and factory mounted. Cleaning tools, cleaning and water conditioning compound are shipped with package.

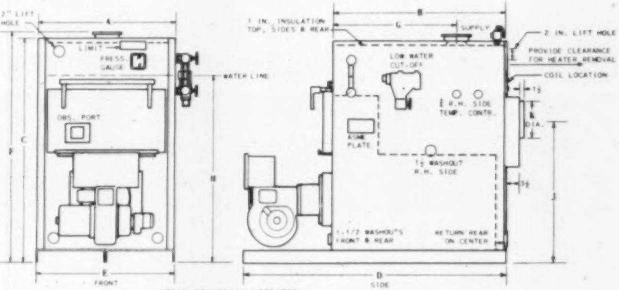
STEAM TRIM—Pressure gauge, ASME Code safety valve, water gauge glass, pressure limit control and a low water cutoff.

WATER TRIM—Combination altitude-temperature pressure gauge, ASME Code relief valve, and temperature limit control.

OIL BURNER—Forced draft fan, M-H RA890E electronic combustion safeguard (stack switch optional on PPF 396, PPF 504 and PPF 648), motor starting relay, (line starter ¾ H.P. and larger) electric ignition with ignition transformer, two-stage 300 psi fuel unit, and instantaneous cutoff solenoid oil valve.

GAS BURNER—Forced draft fan, M-H RA890E electronic combustion safeguard, motor starting relay, air flow safety switch, gas electric ignition assembly with 6,000 volt transformer, main and pilot gas pressure regulators, main and pilot manual shut off gas valves, main and pilot automatic gas valves, and manual on-off switch.

GAS-OIL BURNER—Same as gas burner plus gas-oil manual changeover switch, two-stage 300 psi oil unit with instantaneous cutoff solenoid oil valve.



STEAM BOILER ILLUSTRATED

DIMENSIONS

MODEL NUMBER	PPF 324	PPF 396	PPF 504	PPF 648	PPF 792	PPF 1008	PPF 1260	PPF 1512	PPF 1800	PPF 2100	PPF 2400
A - Boiler Width over Jacket	25 5/8	25 5/8	28	32	32	41	41	44	44	Available Shortly	Available Shortly
B - Boiler Length	32 3/8	40 5/8	43	43	50	57	65	61	69		
C - Boiler Height	44 1/8	44 1/8	48	53	53	66	66	69	69		
D - Overall Length	53 1/2	61 3/4	66	66	78	85	85	82	98		
E - Overall Width	26 1/2	26 1/2	28	33	33	42	42	45	45		
F - Supply Height	44 1/8	44 1/8	48	53	53	66	66	71	71		
G - Supply Location	21 5/8	29 5/8	27	30	30	33	33	35	35		
H - Water Line Height	36 5/8	36 5/8	40	44	44	54	54	58	58		
J - Vent Height	28 1/4	28 1/4	31	35	35	44	44	48	48		
K - Vent Diameter	7	7	8	9	9	10	10	12	12		
Supply Size	3	3	4	4	4	6*	6*	6*	6*		
Return Size	3	3	3	3	3	4	4	4	4		
Gas Manifold Size**	3/4	1	1-1/4	1-1/4	1-1/2	2	2	2	2		
Shipping Weight (Lbs. Approx.)	1300	1400	2000	2200	2600	3100	3500	3900	4400		

* American Standard Flange

** Based on minimum of 5" W.C. Gas Pressure and 1000 Btu Natural Gas.

TANK (STORAGE)

Coil No.	Available on Generator	Capacity 40-140° Rise Gallon Per 3 Hours		Coil Tapping Size	Clearance Req'd For Removal
		180°F B.W.	212°F B.W.		
70RS	PPF-324 thru PPF-1260	40	66	1	14"
71RS	PPF-324 thru PPF-1260	60	100	1	17"
72RS	PPF-324 thru PPF-1260	90	150	•1-1/4"	15"
73RS	PPF-324 thru PPF-1260	120	200	•1-1/4"	18"
74RS	PPF-324 thru PPF-1260	180	300	•1-1/4"	27"
75RS	PPF-396 thru PPF-1260	240	400	•1-1/4"	33"
76RS	PPF-792 thru PPF-1260	300	500	•1-1/4"	41"
77RS	PPF-1008 thru PPF-1260	360	600	•1-1/4"	49"
142CS	PPF-1512 thru PPF-1800	250	415	•1-1/4"	29-1/2"
143CS	PPF-1512 thru PPF-1800	300	500	•1-1/4"	30-1/2"
144CS	PPF-1512 thru PPF-1800	420	700	•1-1/4"	35-1/2"
145CS	PPF-1512 thru PPF-1800	500	8300	•1-1/4"	41-1/2"
146CS	PPF-1800	600	1000	•1-1/4"	47-1/2"
152RS	PPF-1512 & PPF-1800	720	1200	•2-1/2"	45-1/2"
153RS	PPF-1800	840	1400	•2-1/2"	51-1/2"

INSTANTANEOUS

Coil No.	Available on Generator	Capacity 40-140° Rise Gallon Per 1 Hour		Coil Tapping Size	Clearance Req'd For Removal
		180°F B.W.	212°F B.W.		
81RTF	PPF-324 thru PPF-1260	210	350	3/4"	16"
82RTF	PPF-324 thru PPF-1260	270	450	1"	23"
84RTF	PPF-324 thru PPF-1260	360	600	1"	19"
85RTF	PPF-396 thru PPF-1260	450	750	1"	25"
86RTF	PPF-648 thru PPF-1260	600	1000	1"	31"
91RTF	PPF-792 thru PPF-1260	900	1500	1"	42"
162CTF	PPF-1512 thru PPF-1800	210	350	1"	28-1/2"
163CTF	PPF-1512 thru PPF-1800	300	500	1"	30-1/2"
164CTF	PPF-1512 thru PPF-1800	450	750	•1-1/4"	31-1/2
165CTF	PPF-1512 thru PPF-1800	600	1000	•1-1/4"	37-1/2
166CTF	PPF-1512 thru PPF-1800	750	1250	•1-1/4"	41-1/2"
167CTF	PPF-1800	900	1500	•1-1/4"	46-1/2"

• Male pipe thread, all others are female pipe thread.

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you'll want to know . . .

Battelle Scientists Report on Oxygen Recovery System for Astronauts and Atmospheric Ions

A MAJOR STEP in developing a system to convert an astronaut's breath into oxygen and a comprehensive report on the subject of atmospheric ions were presented last month at the annual meeting of the Institute of Environmental Sciences. Responsible for the presentations were four scientists from the Battelle Memorial Institute.

Oxygen Recovery System

Dr. John F. Foster and Justin S. McNulty have developed a working prototype of a device that converts carbon dioxide into water and carbon. The machine is designed to operate on space voyages as long as three years. The developers said that this is one part of a complete oxygen recovery system which consists of a device to recover exhaled carbon dioxide from the cabin of a space vehicle; the device just developed; and a device to electrolyze the water into oxygen and hydrogen.

Space and weight limitations on very long voyages would make it impossible to carry all the necessary oxygen in tanks or in the form of a chemical compound. Breathable oxygen must be recovered from the carbon dioxide exhaled in the breath of the astronauts, unless some alternate solution is found.

The Battelle apparatus uses an adaptation of the well-known process formerly used to manufacture fuel gas from coals. Carbon dioxide, fed in at a rate of 500 cc per min, reacts with hydrogen over a heated iron-containing catalyst (a combination of steel wool and iron oxide pellets) to produce water vapor and solid carbon.

The condensed water vapor will be fed to an electrolytic cell (now under development at Battelle) where it will be broken down into breathable oxygen and hydrogen. The hydrogen will be used to react with more carbon dioxide. The solid carbon will be removed from the reactor every two or three days and discarded.

The engineering prototype is less than 5 ft high, occupies about 2 sq ft of floor space, and weighs about 200 lb. Redesign of the apparatus prior to its use in a space probe is expected to increase the conversion rate and capacity while cutting the weight substantially.

Atmospheric Ions

Astronauts might be faced with the problem of concentrated doses of atmospheric ions, according to Dr. Howard G. Schutz and Richard A. Duffee of Battelle. Atmospheric ions — tiny particles and gas molecules with positive or negative electrical charges — may significantly affect human behavior in space vehicles, nuclear submarines, and even in everyday situations, the men said.

There is no question that the ions do affect human behavior. The unpredictable factor is the amount of this effect and the ion polarity responsible for the change. The scientists said that further research is needed to investigate the process by which ions affect the human body; con-

you'll want to know

ditions under which effects occur; and means by which ions may be used advantageously.

The astronaut and the submariner may be exposed to ion concentrations considerably higher than normal, and the effects of this increased ion concentration may be enhanced by other invironmental factors such as acceleration stress. In addition, in the past decade, nuclear testing and the increasing use of high-voltage electrical equipment has tended to raise the amount of ions in the atmosphere of our living and working spaces. Thus, the control of air ions may prove to be important in maintaining an optimal environment, not only in space capsules but also in homes and business establishments.

Ions are produced in the lower atmosphere principally by naturally radioactive materials in the earth's surface or in the air, and by cosmic radiation. Other naturally occurring sources include falling snow, water spray, and combustion. Electrical properties of the atmosphere have long been blamed for the irritablility and depression felt by people exposed to winds such at the sirocco of the Mediterranean, the foehn of Switzerland, and the chinook of the Pacific Northwest.

Among the man-made sources of ions are combustion processes, high-voltage discharges, nuclear tests, and electrical equipment. For experimental purposes ions can be produced and controlled by hot wires, X-rays, radioisotopes, high-voltage discharges, and ultraviolet photoionization.

Schutz and Duffee's report reviewed the work of a number of research groups which have studied the effects of air ions on

Continued on page 226

U.S. Navy Research Team Develops Thermoelectric Air Conditioned Suit

A SELF-CONTAINED air conditioned suit that keeps the wearer comfortable in outside temperatures from −40 to 135 F has been developed for the U.S. Navy. The suit is an experimental model for testing the possibility of air conditioned attire for military personnel.

Heating or cooling of the suit is accomplished by thermoelectricity—a refrigeration technique that eliminates the need for conventional moving apparatus. Cooling is accomplished by passing an electric current through thermoelectric couples made of semiconductor materials. Reversing the current causes the materials to heat instead of cool. Temperature control is automatic, maintaining 80 F inside the garment.

Completely airtight, the suit is made of an insulated aluminum-coated fabric. Air for breathing is supplied through a face mask connected to the side of the suit helmet, where incoming air is heated or cooled by a small heat exchanger.

During cooling, the current flow through the elements causes one end of the thermoelectric couples to cool, thus lowering the temperature of the heat exchanger on the inside of the suit. The heat removed from the cool side flows through the thermoelectric elements to the hot-side heat exchanger, from which it is dumped to the atmosphere by a small fan. Another fan, mounted on the same shaft, circulates the cool air within the suit. During heating of the suit, the functions of the two heat exchangers are reversed, according to the Westinghouse Electric Corp.

The only moving parts in the suit's entire air conditioning system are two small fans that circulate and distribute the conditioned air around the wearer. Batteries permit the suit to be independent of any power source for one hour.

THE 135 F heat of this test chamber melts butter, but does not affect comfort of man holding it

AN air conditioning unit that both heats and cools is fitted into the back of new Navy suit

Plant's Bonding Resin Dust Problem Solved with Electronic Air Cleaner

HEAT, humidity and resin dust posed unusual air conditioning problems at the Fuller-Merriam abrasives plant in West Haven, Conn. Because of the sticky bonding agents used in grinding-wheel manufacture, a conventional air conditioning system wouldn't work. Yet air conditioning was necessary for adequate quality-control.

Fuller-Merriam manufactures a complete range of industrial grinding wheels and segments. Depending on the wheel type, aluminum oxide or silicon carbide is mixed with phenolic resins or vitrified bonding agents. Some of the abrasives and resins are finer than powdered sugar. When these ingredients were stirred, the mixing bowls became dust bowls.

MIXING BOWLS become dust bowls when resins are mixed

Quality-Control Problem

Bad as the choking dust was, it was only part of the problem. Heat from nearby baking ovens and humidity which partially cured the bonding agents, caused a sticky coating on hands and machines. Worse, the heat and humidity had a deleterious effect on wheel quality. Big 500 ton presses formed the mixture into "green" wheels, which were stored in the mixing room before being baked. The humidity reacted with the resins, prematurely beginning the curing process and adversely affecting finished wheel quality. Result: too many wheels failed to meet high standards.

To maintain proper quality control, it was decided to air condition the mixing room, holding temperature and humidity within closely controlled limits. But a conventional air conditioning system would be severely limited in the mixing room. The heating coils would act like baking ovens, transforming the sticky resin dust in the air to a hard glasslike coating that would insulate the coils. On the wet cooling coils, the resin powder would react with the moisture, making a thick soggy gluelike coating. Result: no heat transfer on either the heating or cooling coils, and no air conditioning.

DUST SPOT method checks electronic air cleaner efficiencies

The problem was solved by in-

you'll want to know

stalling an electronic air cleaner ahead of the air conditioning system, according to Minneapolis-Honeywell Regulator Co. This removes the resin dust before it reaches the coils, and virtually eliminates dust in the room.

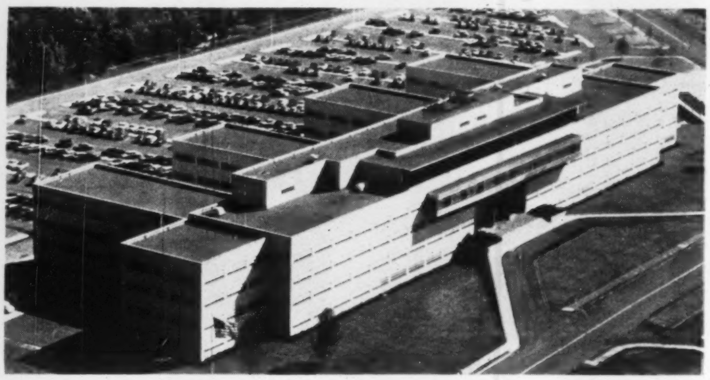
The air is recirculated, with only 5 to 10 percent makeup air brought in to replace interior air lost through the doors and windows. Since this air has already been heated or cooled, only a small amount of additional heating or cooling is needed. Instead of requiring a 420,000 Btu per hr heating unit, a 180,000 Btu per hr furnace is able to supply the heating needs.

Improved quality control was achieved, as were several other benefits. Because the room was cleaner, maintenance requirements were reduced. The men feel healthier and morale is higher.

Lockwood Greene Engineers Elect J. Robert Potter President and Treasurer

J. Robert Potter has been elected president and treasurer of Lockwood Greene Engineers, Inc. He succeeds William J. Heiser, president and treasurer since 1954, who has been elected chairman of the board. Samuel B. Lincoln, former board chairman, has been named honorary chairman of the board and remains a company director.

Lithium Chloride Units, 350 Ton Compressor And Small Reservoir Team Up To Cool Office Building



Cooling the general office building of the Tennessee Coal & Iron Div., Fairfield, Ala., has been accomplished by using four lithium chloride units, a 350 ton compressor, and the cool water of a nearby reservoir. The structure is part of a complex that involves fully integrated steel operations — from raw-material mining to manufacture of finished products.

The TCI division of the United States Steel Co. produces sheet steel, tin plate, wire, structural steel, and other products. More than 100,000 people derive their livelihood from its mines, mills, and offices.

The general office building is four stories high and a block and a half long. Total area of the building is 315,000 sq ft, with total space of more than 4 million cu ft. Some 2500 windows equipped with stainless steel solar shades provide natural lighting. On the top of the building is a penthouse cafeteria accommodating 450 people. The year around air conditioning has individual office thermostatic control, according to Fred E. Dick, design engineer for the Surface Combustion Div., Midland-Ross Corp.

The cooling system uses 80 percent outside air and 20 percent return air. The return air is taken from the machine room plenum. Outside air is first passed through cleanable filters.

The air then goes to four washer units where it is sprayed with a solution of lithium chloride. The washer units take in air up to 125 grains of moisture per lb of air and reduce this to 26 grains. The four units supply 70,000 cfm of dry air at 72 F.

Thirty-four secondary units throughout the building provide aftercooling using water from TCI's reservoir. Ideally, the water should be 52 F or lower. The water temperature depends upon the level in the reservoir and upon the nature of the preceding winter. If conditions are such that the water needs cooling, a 350 ton refrigeration unit in the basement is used for this purpose.

Accumulated moisture in the lithium chloride solution is removed by passing about 10 or 15 percent of the solution over steam coils. As it is heated, the water evaporates, and then the solution flows back into the washer.

The density of the solution and its temperature are regulated by automatic controls in the washer units. These units are served by two regenerators.

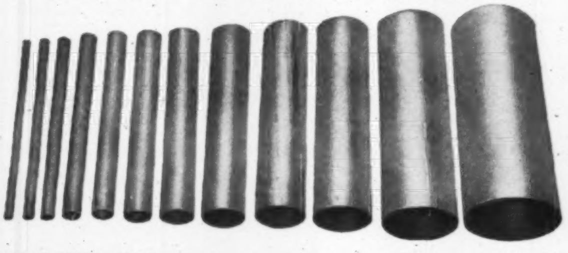
The System is designed to keep air at 45 percent relative humidity at a temperature of 78 F.

Van-Cor®

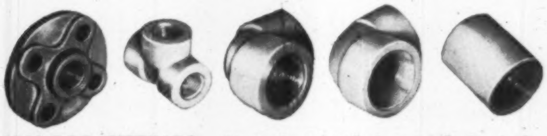
THE ANSWER TO CORROSION PROBLEMS

WHAT IS VAN-COR? Van-Cor is rigid unplasticized polyvinyl chloride. Available in two types: Van-Cor 1—*Normal Impact* and Van-Cor 2—*High Impact.*

ADVANTAGES OF VAN-COR—Van-Cor is highly resistant to corrosion by hundreds of industrial acids and alkalies. Van-Cor is light in weight (½ that of aluminum). Van-Cor has high tensile strength and low flow resistance. Van-Cor is easily installed because it can be formed, machined, threaded and welded.



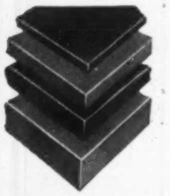
VAN-COR PIPE—Diameter sizes from ¼" thru 12". Available in 10 ft. or 20 ft. lengths.



VAN-COR FITTINGS—Sizes from ¼" thru 12". Includes: threaded fittings, socket fittings, flanged fittings, belled fittings and special fittings.

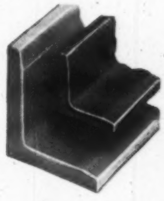
VAN-COR VALVES

Sizes from ½" thru 3". Types include diaphragm valves, plug valves, lift check valves, ball check valves, ball valves, and Walworth "Y" globe valves.



VAN-COR SHEETS

Thicknesses range from 1/32" thru 2". Sheet stock size is 48" x 96". Transparent on special order.



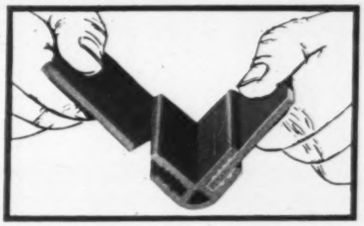
VAN-COR EXTRUDED 90° ANGLES

Sizes: 1½" x 1½" x 3/16" and 2" x 2" x ¼". 10 ft. lengths.

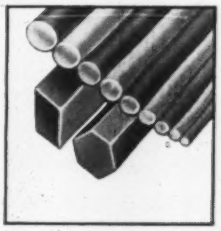
* * * *

TUFTITE® PVC pipe is unaffected by sewage or harmful soil conditions. Will not break in storage, installation or use. Roots cannot penetrate Tuftite's bonded joints. Lightweight; easily installed. Tuftite is available Plain or Perforated, 2" thru 6" diam., 10' or 20' lengths. Tuftite fittings are also available.

VAN-COR JOINING STRIPS

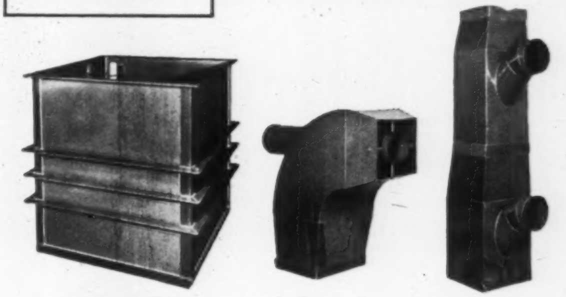


For connecting PVC stock by solvent welding. 90° joining strips for corners, H strips for a single plane. For sheet gauges of ⅛", 3/16", ¼". 10 ft. lengths.



VAN-COR BAR STOCK

Round bars, ¼" thru 2" diam. in 10 ft. lengths. 2½" thru 4" in 5 ft. lengths. Hexagonal bars, 7/16" thru 2" in 10 ft. lengths.



VAN-COR CUSTOM FABRICATIONS
Colonial will fabricate to your specifications hoods, tanks, ducts, tank linings, etc.

OTHER FORMS—Van-Cor is also available in Welding Rods, Bolts and Nuts, Extruded Seamless Duct, Fabricated Duct, and Custom Extrusions.

VAN-COR CATALOG

Request complete catalog containing detailed specifications, diagrams, flow charts, chemical resistance tables and installation data.

Engineering Service Available

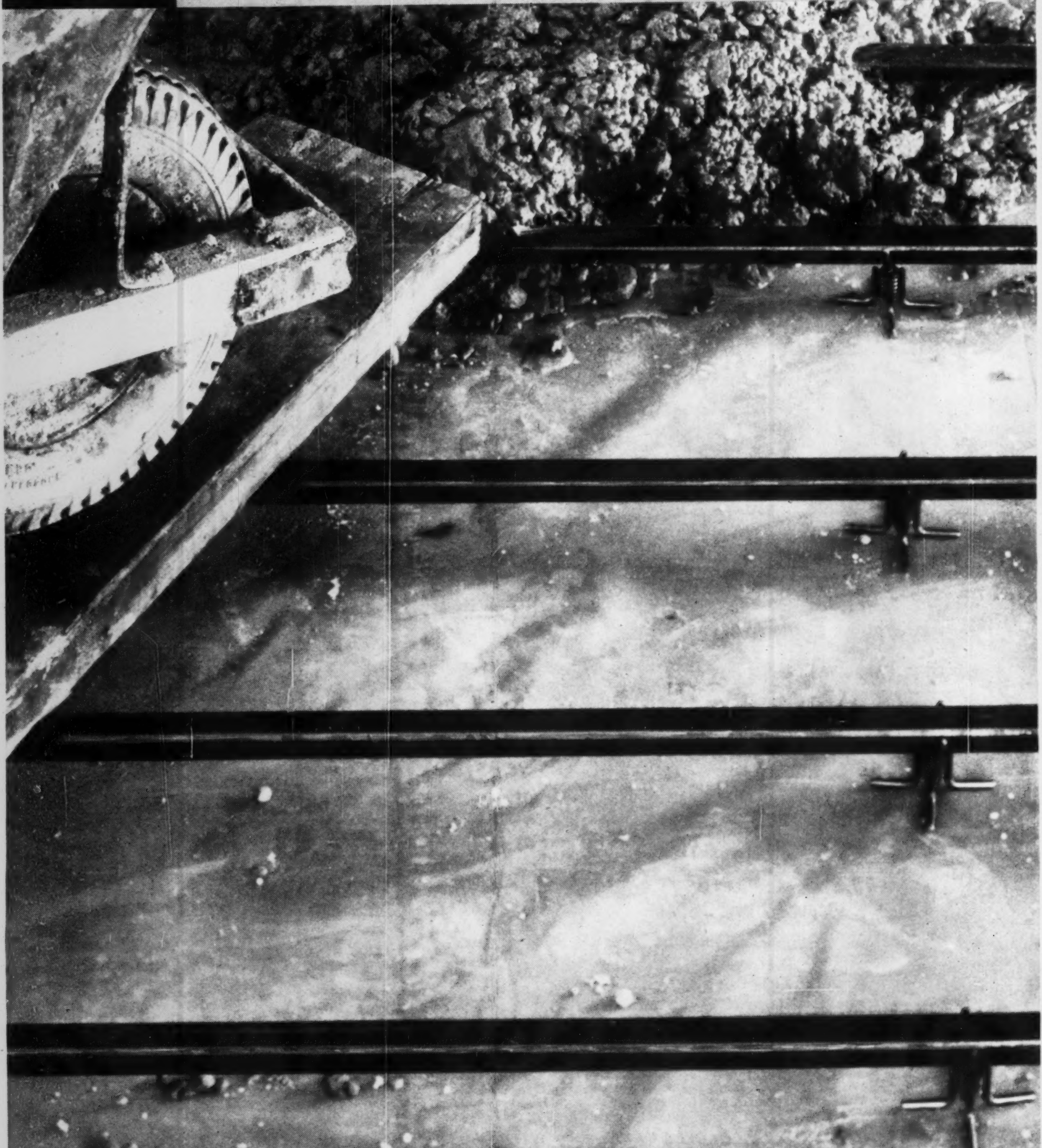
INDUSTRIAL DIVISION OF . . .

COLONIAL PLASTICS MFG. CO.

Subsidiary of the Van Dorn Iron Works Co.
2685 EAST 79TH STREET • CLEVELAND 4, OHIO

Steel

STEEL PIPE BY WHEELING



So easy to use... so hard to abuse!

Bend it . . . bang it . . . bury it under tons of concrete! Rugged Wheeling CW Steel Pipe takes such torture in stride. Then keeps on taking it long after most other pipe has failed!

Long experience under a wide range of conditions has proved that Wheeling Pipe has the strength and dependability needed for economical service and continued safe use for years to come.

Wheeling Pipe can withstand amazing abuse. That's because it makes full use of steel's inherent strength and dimensional stability . . . and it's always produced under exacting *American* quality standards.

It's easy to use and handle, too. Made of uniform steel – Wheeling Pipe has even wall thicknesses and accurate circumferences. So this rugged pipe cuts easily . . . bends smoothly . . . welds surely.

Ask your Wheeling man about Wheeling CW Steel Pipe, both black and galvanized. Or write to Wheeling Steel Corporation, Wheeling, West Virginia.

WHEELING STEEL

WHY WHEELING STEEL PIPE IS FIRST CHOICE!

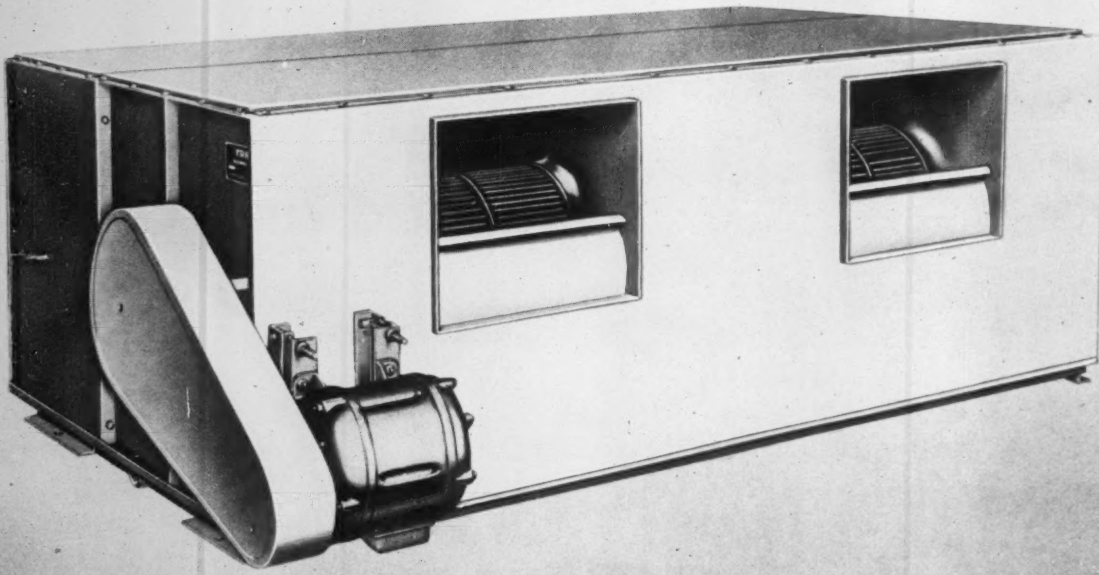
- *Lowest cost with durability*
- *Strength unexcelled for safety*
- *Formable – bends readily*
- *Weldable – easily, strongly*
- *Threads smoothly, cleanly*
- *Sound joints, welded or coupled*
- *Grades, finishes for all purposes*
- *Available everywhere from stock*

ALWAYS INSIST ON PIPE MADE IN THE USA!

WHEELING STEEL CORPORATION · IT'S WHEELING STEEL!

District Sales Offices at Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis, San Francisco, Wheeling

You'll solve more with Trane Central



Here's why TRANE Climate Changers solve more difficult application, installation and maintenance problems:

- **Compactness.** Substantially reduced dimensions solve problems of limited installation space while maintaining top performance.
- **More sizes.** For efficient application flexibility, there are 14 sizes in the Standard (draw-through) type, and 13 sizes in the Multi-Zone double duct (blow-through) type. Each type covers the range of 6 to 63 sq. ft. coil face area.
- **Reliable ratings.** TRANE Climate Changers are fully tested and accurately rated as complete assemblies.
- **Exclusive one-inch O.D. tube non-freeze steam coil.** Provides uniform leaving air temperature over full face area of coil down to 6 per cent of full loading.
- **Exclusive Multi-Zone damper design** provides positive all-round seal for both hot and cold decks to eliminate leakage.
- **Life-lubricated ball bearings** prevent start-up damage due to improper on-the-job lubrication procedures. Eliminates time-consuming lubrication maintenance.
- **Improved mixing box** and damper design assures complete mixing of outside and return air, eliminates stratification.
- **Complete fan assembly electronically balanced** in unit before shipment, assures unit will operate without vibration.

Advanced engineering features assure high performance of Trane Coils!

The TRANE Sigma-Flo Fin design increases heat transfer efficiency. Casing design reduces over-all dimensions, eliminates air by-passing the coil, minimizes moisture carry-over on dehumidifying coil. Heating coils feature a non-freeze design with one-inch O.D. tubes as standard. The cooling coil line features an all-purpose coil, a completely drainable coil, a completely cleanable coil and a direct expansion coil. Sigma-Flo Fins have S-shaped contours to assure uniform air turbulence over the *total* fin. The result is high heat transfer efficiency. Tubes are mechanically expanded into wide fin collars to provide a permanent solderless bond.

These advanced engineering features are yours in *standard* TRANE Coils—priced competitively with conventional coils! Ask your nearby TRANE Sales Office for complete facts on these coils—and about the cooling coil selection method (exclusive with TRANE) that saves time, assures unparalleled pinpoint accuracy!

air handling problems Station Climate Changers!

Superior versatility. Unmatched flexibility. Wider range of sizes. And, an advanced coil design, exclusive with Trane!

Here is the latest advance in central station air conditioners: TRANE Climate Changers, with exclusive engineering features, quality built throughout. These units are highly compact, have unequaled versatility; and there are over 100 standard units to enable you to meet the exact requirements of any job more accurately.

You can select TRANE Climate Changer units, step-by-step, to meet the most exacting job specifications. The result is a system of perfectly matched components to meet your specific air conditioning requirements. There are draw-through and Multi-Zone models—available in both medium and low-pressure types, in a widened range of capacities from 1,200 to 47,000 cfm.

Ratings for consistent and accurate performance of TRANE Climate Changers have been established after nearly 30,000 man hours of engineering, research and testing.

The Climate Changer fan assembly is electronically balanced before shipment to provide greater protection against vibration.

Next time you're planning a job calling for a central station unit, ask your nearby TRANE Sales Office for complete facts on the Climate Changer line. Or, if you prefer, write directly to TRANE, La Crosse, Wisconsin.

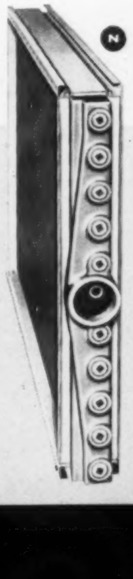
For any air condition, turn to

TRANE

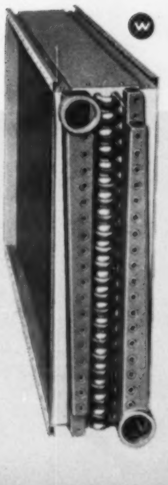
MANUFACTURING ENGINEERS OF AIR CONDITIONING,
HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

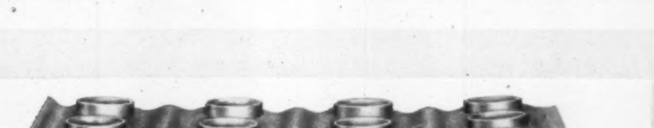
THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 100 U. S. AND 19 CANADIAN OFFICES

Type N steam coil, non-freeze design, with one-inch O.D. tubes that provide uniform temperature distribution across coil face. Positive protection against freeze-up.



Type W all-purpose water cooling coil, from return end. Rugged cast-iron headers with hydrodynamic design provide most efficient flow distribution, assure uniform distribution to all tubes and minimum pressure drop.

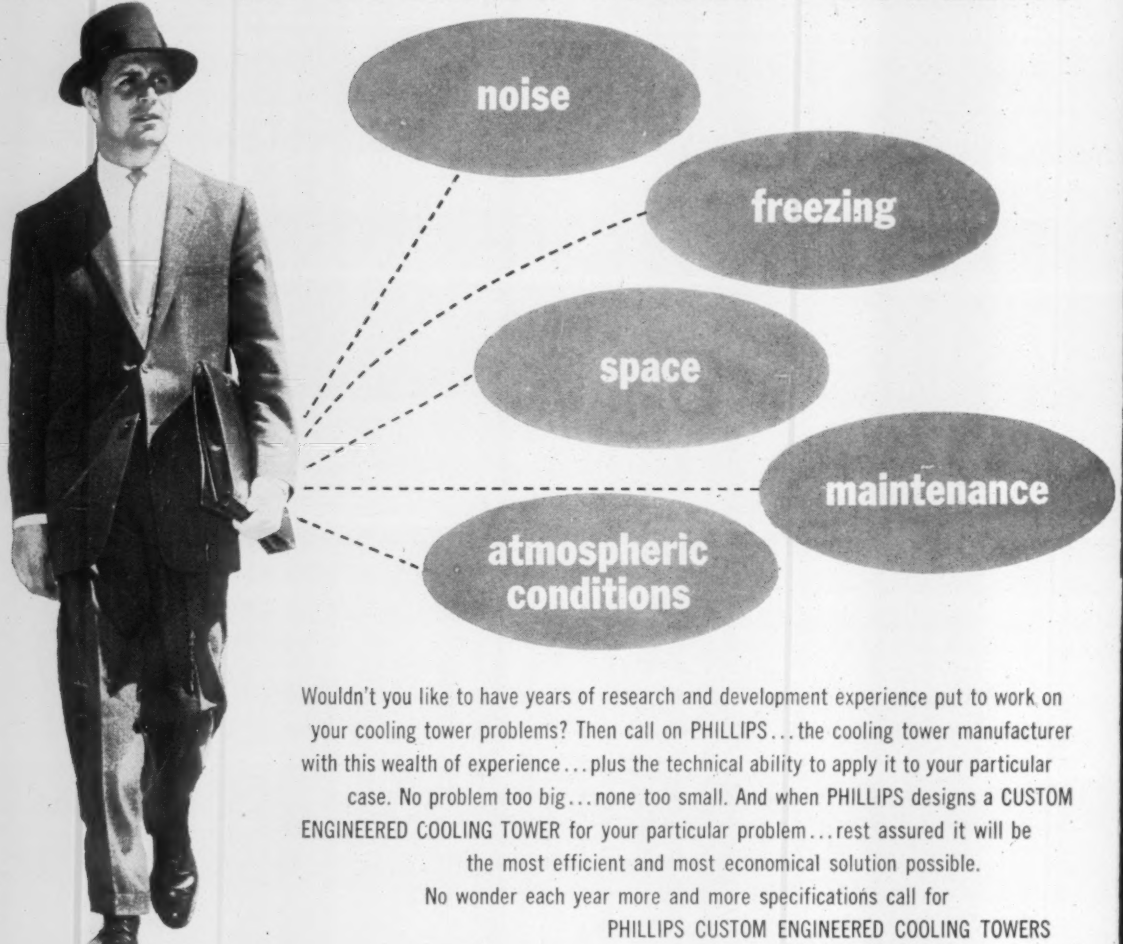




New Sigma-Flo Fin features wavy design that improves heat transfer efficiency, results in more compact design. Fins, die-formed in multiple stages, provide accurate tube fits and fin bonding spacing.

CALL ON *Phillips* CUSTOM ENGINEERING

TO SOLVE YOUR COOLING TOWER PROBLEMS



Wouldn't you like to have years of research and development experience put to work on your cooling tower problems? Then call on PHILLIPS... the cooling tower manufacturer with this wealth of experience... plus the technical ability to apply it to your particular case. No problem too big... none too small. And when PHILLIPS designs a CUSTOM ENGINEERED COOLING TOWER for your particular problem... rest assured it will be the most efficient and most economical solution possible.

No wonder each year more and more specifications call for PHILLIPS CUSTOM ENGINEERED COOLING TOWERS

EVERY STEP CUSTOM ENGINEERED

CASINGS
Selection of material to fit Architectural treatment and surrounding conditions.

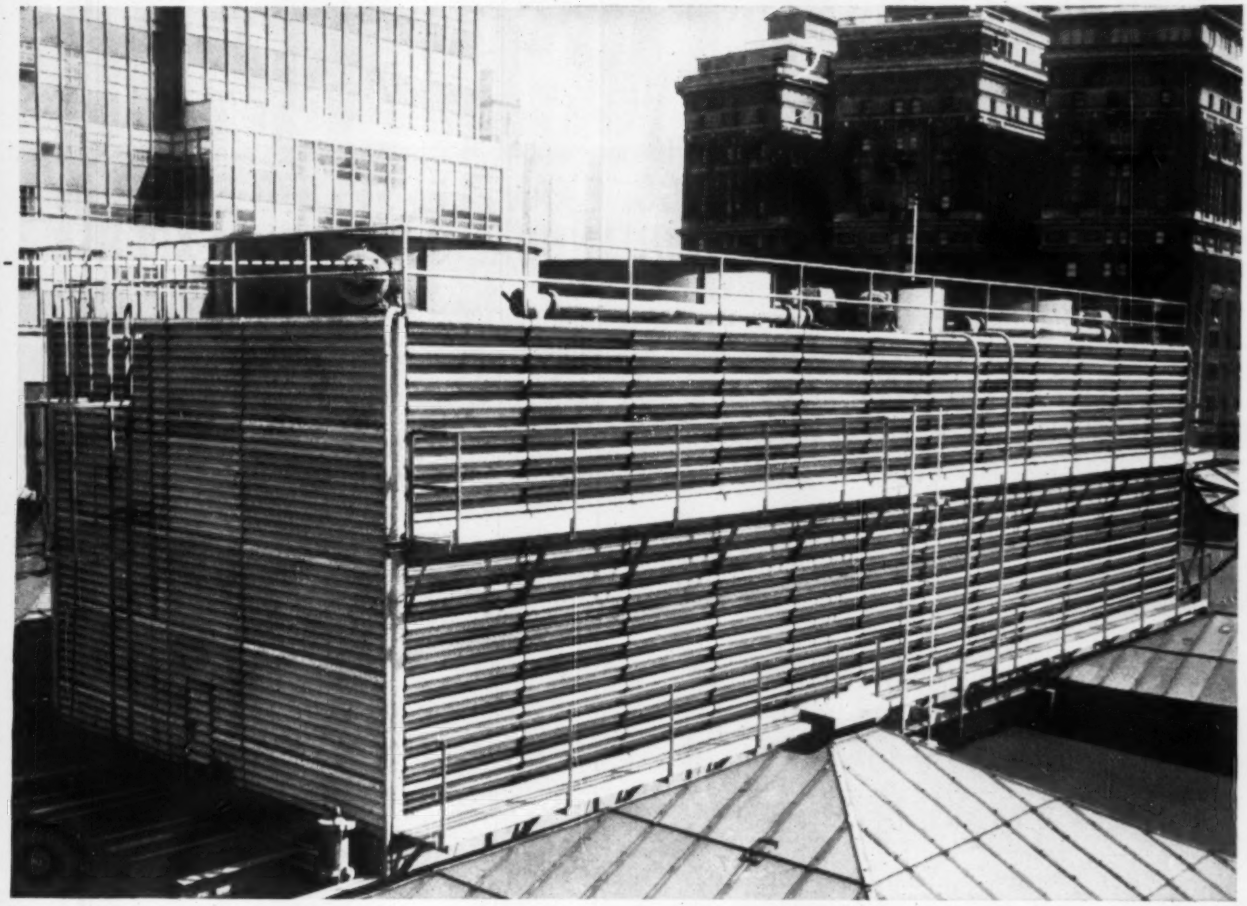
BASINS
Redwood, stainless steel, galvanized steel, carbon steel up to and including ¼" thickness with any desired coating, reinforced concrete basins supported on steel beams.

DISTRIBUTION SYSTEM
Spray nozzle type or open Weir gravitational type system.

FANS
Multi-blade, adjustable propeller type fan in cast aluminum, stainless steel or Monel. Either direct driven fan in small sizes or indirect right angle worm gear drives.

FILL
Redwood or pressure treated Douglas Fir. Slip-fit, self-supporting for easy removal for interior maintenance.

FRAMEWORK
Hot dipped galvanized structural steel .250" minimum thickness. Redwood or pressure treated Douglas Fir.



GIMBEL'S DEPARTMENT STORE, New York City
Consulting Engineer: Charles S. Leopold, Philadelphia, Pa.

another problem solved by Phillips

CUSTOM ENGINEERED COOLING TOWERS

the problem:

To provide a cooling tower as free from maintenance as possible and yet perform efficiently in the limited area.

the solution:

PHILLIPS CUSTOM ENGINEERED COOLING TOWER with "Dual-Airstream" design, modified to provide accessibility under fill. Hot dipped galvanized framework field-coated with butyl rubber to further improve service life. Walkways provided at two levels for easy inspection and maintenance.

result:

A trouble-free cooling tower that provides maximum efficiency for one of the world's largest department stores.

SPECIAL FEATURES ON ALL TOWERS

Corrosion Resistant Hardware. Aluminum or Stainless Steel Fans. Nailless Redwood Filling Removable at Tower Base. Nailless Three-Pass Redwood Eliminators. Removable Louvers.

WRITE FOR LITERATURE

Phillips
Cooling Tower Co., Inc.
220 DUPONT ST., BROOKLYN 22, N.Y.

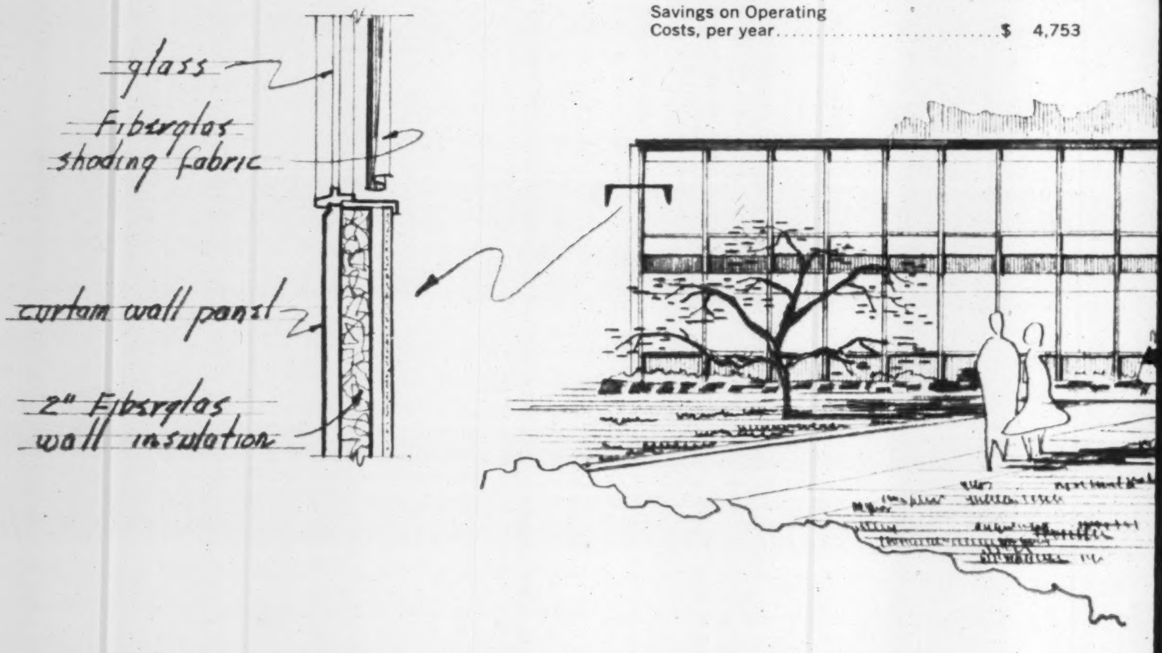
DIVIDEND ENGINEERING*

PROJECTS IMPORTANT SAVINGS. EXAMPLE: $16,870 SAVED IN INITIAL COST. $4,753 SAVED IN ANNUAL OPERATING EXPENSE

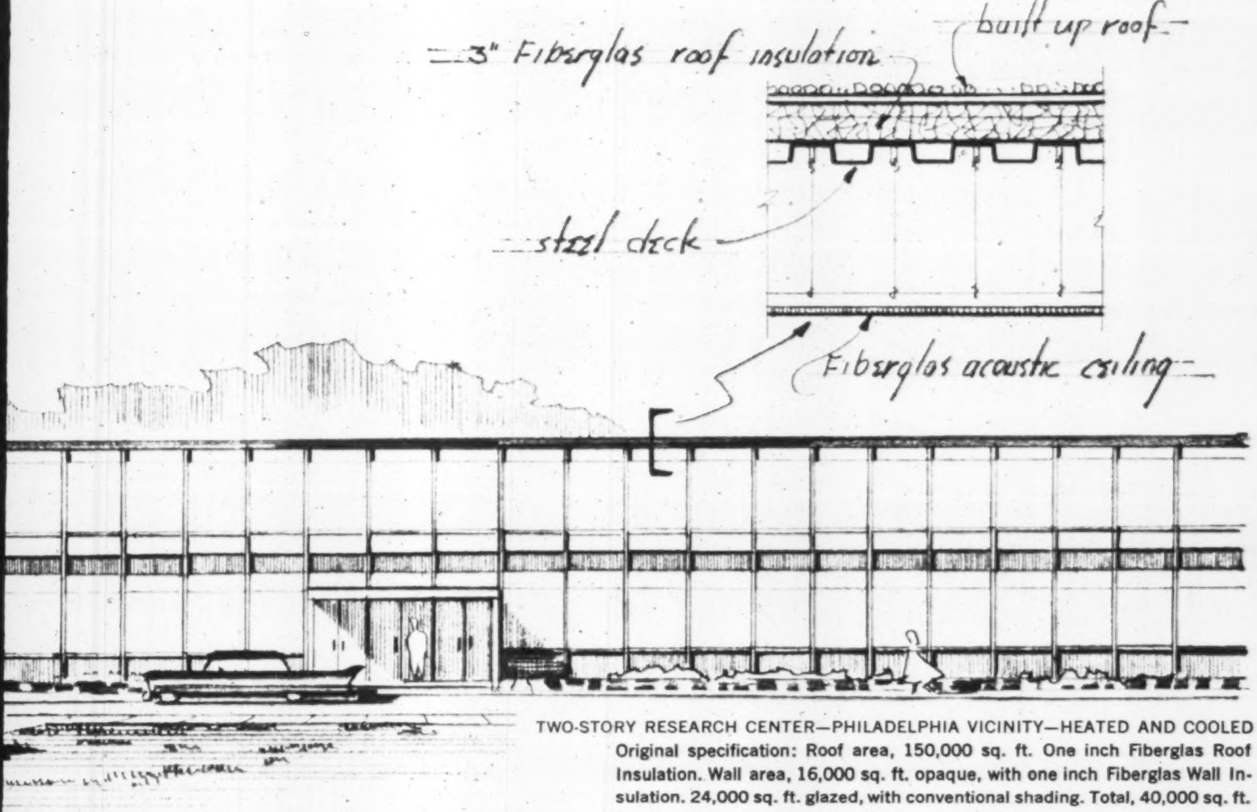
Dividend Engineering is a new, quick method of pinpointing insulation specifications that can project significant savings in initial and operating costs. The example shown illustrates how this system works: roof insulation is increased from one to three inches; wall insulation from one to two inches. Fiberglas† Shading Fabrics are specified for windows. Results: extra insulation cost is $42,000. But it effects a $16,870 saving in initial equipment, plus a projected annual operating savings of $4,753...

DIVIDEND ENGINEERING
DOLLAR SAVING PROPOSAL

	Original Specifications	Dividend Engineering Specifications (Illustrated)
Cost of Heating & Cooling Equipment	$189,450	$130,580
Savings		$ 58,870
Additional Construction Cost		$ 42,000
Net Savings on Initial Costs		$ 16,870
Projected Annual Operating Costs	$ 64,222	$ 59,469
Savings on Operating Costs, per year		$ 4,753



a high return on the initial investment. Such savings make the production and comfort benefits of year-'round air conditioning an economic possibility for more and more industrial and commercial structures... Let us demonstrate Dividend Engineering on one of your current projects. Contact your local Fiberglas representative, or write Owens-Corning Fiberglas Corporation, Industrial & Commercial Division, 717 Fifth Avenue, New York 22, New York.



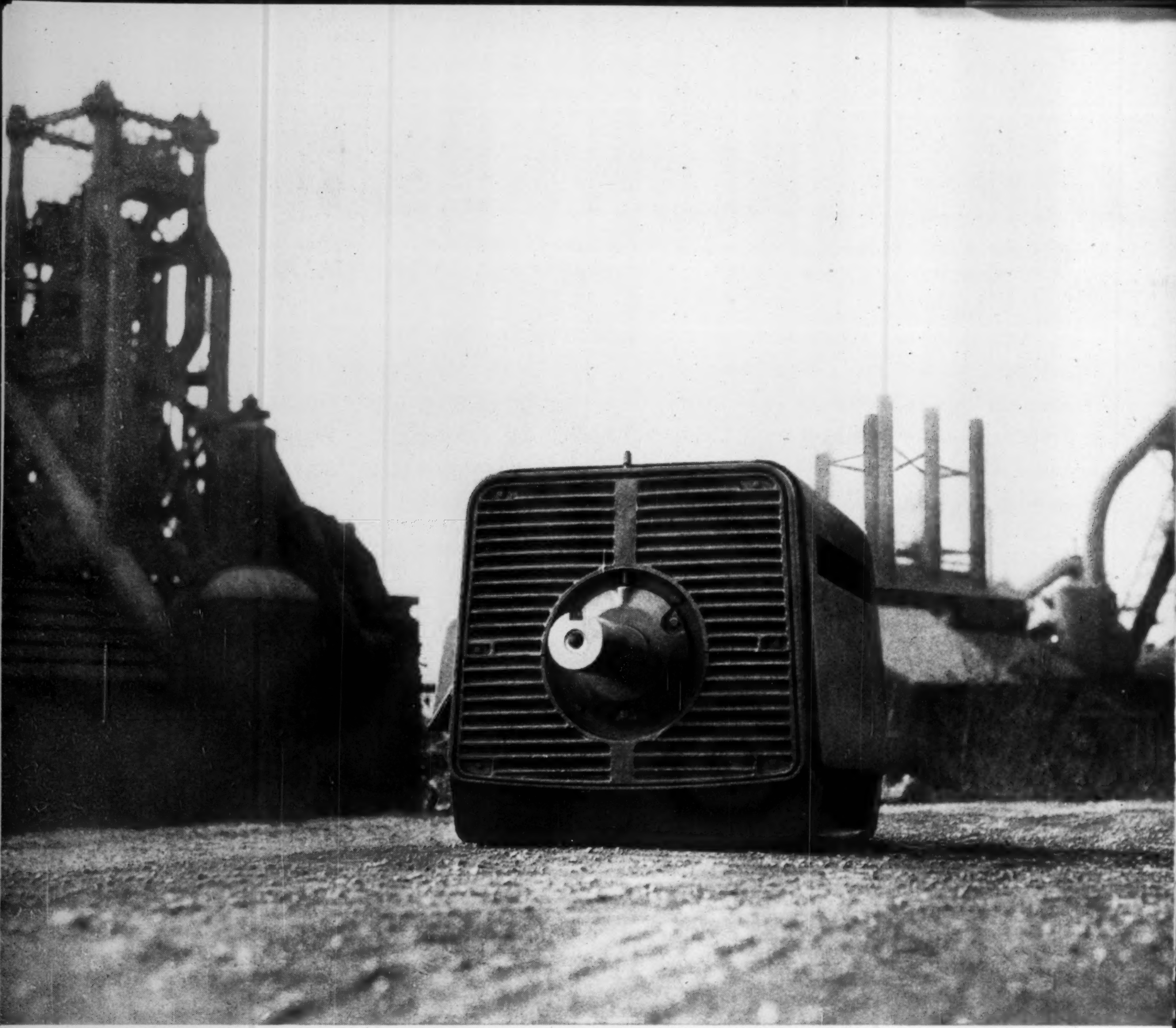
TWO-STORY RESEARCH CENTER—PHILADELPHIA VICINITY—HEATED AND COOLED
Original specification: Roof area, 150,000 sq. ft. One inch Fiberglas Roof Insulation. Wall area, 16,000 sq. ft. opaque, with one inch Fiberglas Wall Insulation. 24,000 sq. ft. glazed, with conventional shading. Total, 40,000 sq. ft.

**A service Owens-Corning will provide to demonstrate to builders, designers, management and financial groups that optimum use of Fiberglas materials can result in reduced initial and operating costs and improved building performance.*

OWENS-CORNING RESEARCH pioneers in making things better with Fiberglas

OWENS-CORNING
FIBERGLAS

†T. M. (REG. U. S. PAT. OFF.) O-C. F. CORP.



America's Newest Compact

Here is how the Reliance D-5000 design shrinks, cools and quiets 125-2000 hp. motors.

This new, great cubic design gives you more horsepower in less space . . . actually the frame dimensions that held 150 hp. now contain 300 hp. There is better heat dissipation from the frame itself. Air flows easily through the entire grilled end areas . . . exhausting through long, protected slots at the sides and bottom. New fingerless ducted rotor design also means considerably better cooling than any other previous motor. Noise level is held to a minimum.

Reliance has incorporated all other Duty Master plus features into this motor . . . ball or sleeve bearings, special lubrication design, drip or splash-proof and complete open motor protection in its insulation characteristics. The Reliance Duty Master is built up to 2,000 horsepower; the D-5000, available now, runs from 125 to 300 hp.

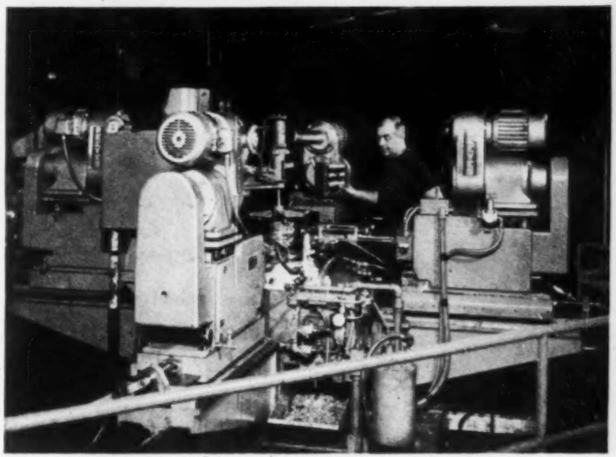
The Reliance Sales Engineer that serves you is anxious to tell you the full story of this new Duty Master. Call him. He's in the Yellow Pages.

BUILDERS OF THE TOOLS OF AUTOMATION

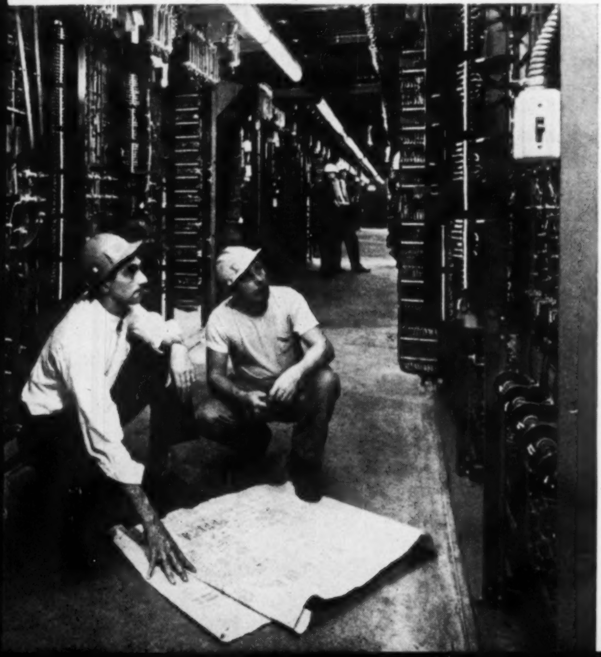
A-1684

ONE SELF-CONTAINED, COMPACT POWER PACKAGE. This MASTER GEARMOTOR has been operating outdoors for 5 years regardless of weather. It has no exposed high speed couplings, no V-belts, chains or sprockets. Engineering and assembly costs are reduced. You can simplify installations and save space with vertical, horizontal and flange mountings; output shaft over, under, left or right. Ratings 1/8 to 125 hp. in right angle, parallel or in combination. Right angle ratios are available up to 96:1; parallel 120:1. Bulletin A-1684.

CONTOUR EPOXY-COATED TO ELIMINATE ENCAPSULATION CRACKING. New RELIANCE ENCAPSULATED MOTOR . . . gives you positive protection from dust, dirt, acid and water. Unlike other heavy molded coatings, stator windings are vacuum-impregnated with epoxy resin at a uniform thickness, follow the contour of the windings. You get maximum flexibility, tensile and bond strength, plus quicker cooling . . . all vital to superior motor performance. Bulletin B-2108.



INFINITELY VARIABLE OUTPUT SPEEDS AT LOW COST. REEVES MOTODRIVES, shown here powering this 4-position drilling and boring machine, are used extensively for hundreds of production needs. Horsepower ratings from ¼ to 40, speeds from 1.71 to 4660 rpm. Speed variation ranges from 2:1 to 10:1. Available in hundreds of space-saving assemblies . . . with manual, remote or automatic process control (Airtrol). Bulletin M 592.



TOTAL SERVICE is an integral part of every Reliance product, from engineering and start-up assistance to maintenance and renewal parts. The photo shown here is typical of a Reliance Service Engineer's on-the-job availability—for maintenance and consultation on knotty problems. Every Reliance Sales Engineering Office and Distribution Center—nationwide—gives you the attention and experience necessary to assure the top performance you expect from the Reliance equipment you buy.

RELIANCE ELECTRIC AND ENGINEERING CO.

Dept. 365A, CLEVELAND 17, OHIO • Canadian Division: Toronto, Ont.

Campbell

WARM AIR HEATERS FOR LARGE BUILDINGS

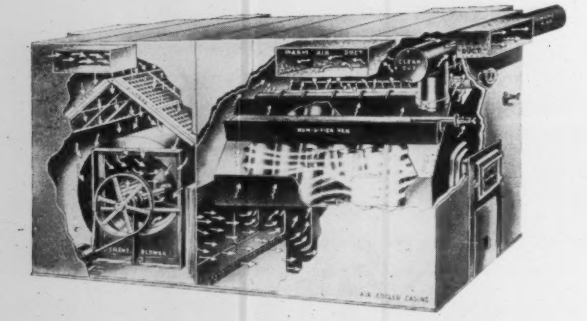
Trinity Lutheran Church, Lowden, Iowa, heated with an oil-fired Campbell 8000 series heater. Architect, The Griffith Co., Fort Dodge, Iowa; Heating Contractor, Lowden Plumbing and Heating Co.

ECONOMY AND FLEXIBILITY

Campbell Warm Air Heaters deliver the maximum in economy and flexibility for church heating. Low in first cost, easy to install, and remarkably economical to operate. They provide fast heat delivery, are extremely quiet, and easily adaptable for summer air conditioning. On your next church heating job, build your plans around a Campbell Heater.

MANUFACTURERS' AGENTS

We have some attractive openings for men calling on heating contractors and architects.



CAMPBELL
HEATING COMPANY

Des Moines 17, Iowa

You get more value for the same dollar— in the NEW Bulletin 709 line of starters!

SIZE 00

BULLETIN 709 SIZE 5
A-B QUALITY
ALLEN-BRADLEY COMPANY

SIZE 5

A-B QUALITY

This new line of Allen-Bradley motor control will change every idea you have had about starter size, performance, and life. The small size—especially in the higher ratings—is startling. Yet rating for rating the operating life and reliability have been increased many times. Built into each of the seven sizes of this new Allen-Bradley line is an ability to interrupt tremendous currents and to operate year in and year out for many millions of operations without trouble or maintenance.

The new Bulletin 709 starters are just as advanced in appearance as they are in performance. All seven sizes have an aristocratic styling and a distinctive family likeness. Brooks Stevens, famous industrial designer, has given the enclosures such an attractive, modern style that these new starters will prove a distinct sales asset on any machine or installation.

Why not write today for more information on this revolutionary new line of Allen-Bradley Bulletin 709 *quality* across-the-line motor starters?

Note the compactness of both the smallest and largest starter in the new Bulletin 709 line. Ratings up to 100 hp, 220 v; 200 hp, 440-550 v.

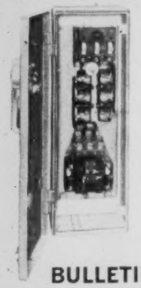
12-61-RM

ALLEN-BRADLEY

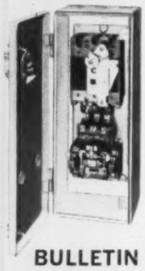
Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

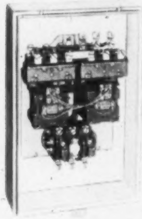
QUALITY MOTOR CONTROL



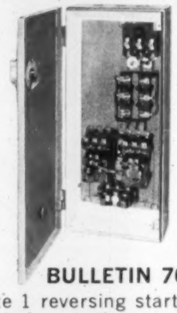
BULLETIN 712
Size 1 combination starter with fused disconnect switch



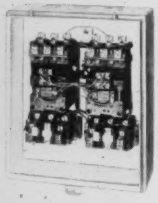
BULLETIN 713
Size 1 combination starter with circuit breaker



BULLETIN 705
Size 2 across-the-line reversing starter with overload relays



BULLETIN 706
Size 1 reversing starter with fused disconnect switch



BULLETIN 715
Size 1 across-the-line, multi-speed starter with overload relays

BULLETIN 717
Size 2 multi-speed starter with circuit breaker

BULLETIN 702
Size 3 three-pole, a-c solenoid contactor

A-B
QUALITY

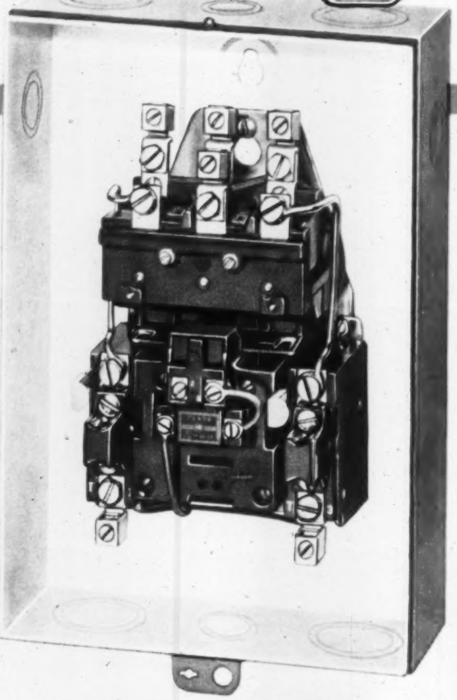
Pygmies in Size Giants in Performance—

the NEW Allen-Bradley Across-the-Line Starters!

This new line of across-the-line motor starters is the result of over 30 years of experience and leadership in the motor control field.

While retaining the simple solenoid principle—with only ONE moving part—these starters are completely new in every way. They are amazingly small in size—yet test after test has proved they will not only outperform but also outlast any starter now on the market. They are good for *many millions* of trouble free operations. All have scores of design refinements that make them easier to install and maintain. All are available in the smart new enclosures designed by Brooks Stevens. They make a beautiful addition to any machine or control installation.

You'll want to get the complete story about these truly revolutionary new across-the-line starters. Write for new Publication 6100.



BULLETIN 709

This popular across-the-line solenoid starter shows the new Size 2 construction. Note the white interior and generous wiring space. Bulletin 709 starters are available, in the new construction, in seven sizes—Sizes 00 to 5, with a maximum rating of 100 hp, 220 v; 200 hp, 440-550 v.

12-61-RM

ALLEN-BRADLEY

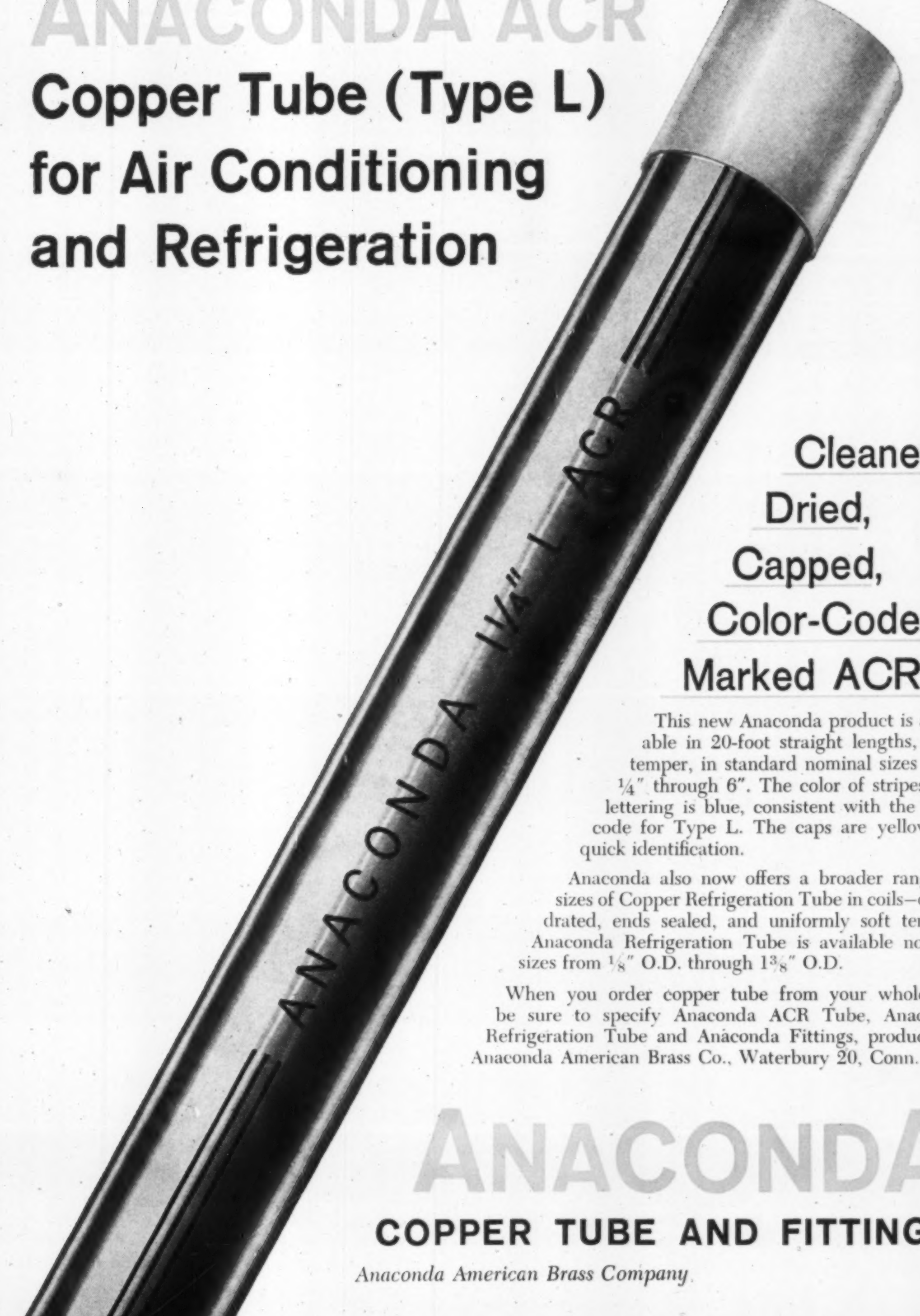
Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

QUALITY MOTOR CONTROL

Now available

ANACONDA® ACR
Copper Tube (Type L) for Air Conditioning and Refrigeration



Cleaned,
Dried,
Capped,
Color-Coded,
Marked ACR.

This new Anaconda product is available in 20-foot straight lengths, hard temper, in standard nominal sizes from ¼" through 6". The color of stripes and lettering is blue, consistent with the color code for Type L. The caps are yellow for quick identification.

Anaconda also now offers a broader range of sizes of Copper Refrigeration Tube in coils—dehydrated, ends sealed, and uniformly soft temper. Anaconda Refrigeration Tube is available now in sizes from ⅛" O.D. through 1⅜" O.D.

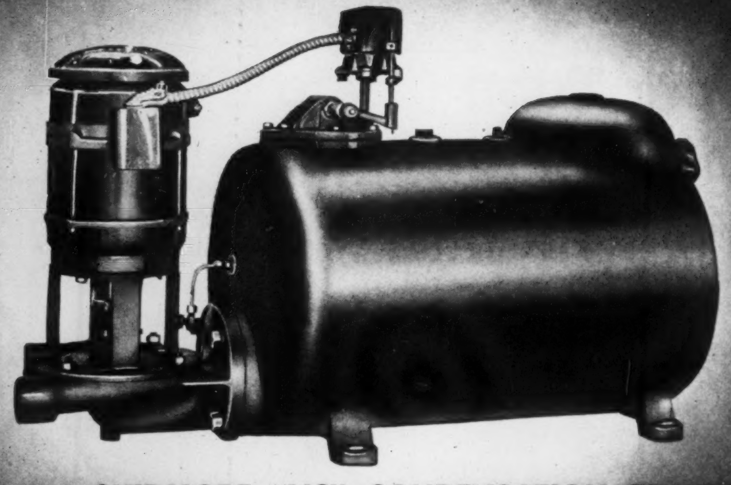
When you order copper tube from your wholesaler be sure to specify Anaconda ACR Tube, Anaconda Refrigeration Tube and Anaconda Fittings, products of Anaconda American Brass Co., Waterbury 20, Conn. 6029 L

ANACONDA®

COPPER TUBE AND FITTINGS

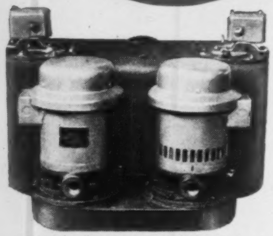
Anaconda American Brass Company

One is just right for your application



SKIDMORE "VC" CONDENSATION PUMP

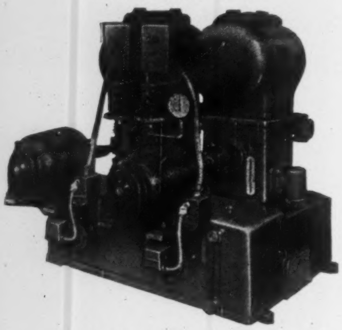
- **Quiet Operation • Low inlet connection**
- **Accessibility Without Disturbing Piping**



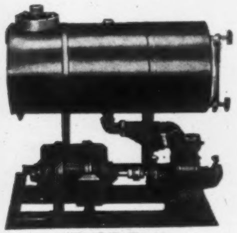
TYPE CCVS—DUPLEX
Bulletin No. 21-C

You can meet your exacting needs in heating pumps with Skidmore. For quiet, dependable operation, a Skidmore Pump combines the latest features in centrifugal pump design with a minimum of space requirements and a wide range of selectivity. Designed to return condensate to the boiler or other points . . . pump unit operates free of any close-clearances, assuring longer operational periods without cost for service or maintenance.

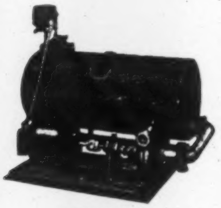
MAINTAINED SKIDMORE PUMPS EFFICIENCY



VACUUM PUMP
Bulletin No. 9-B



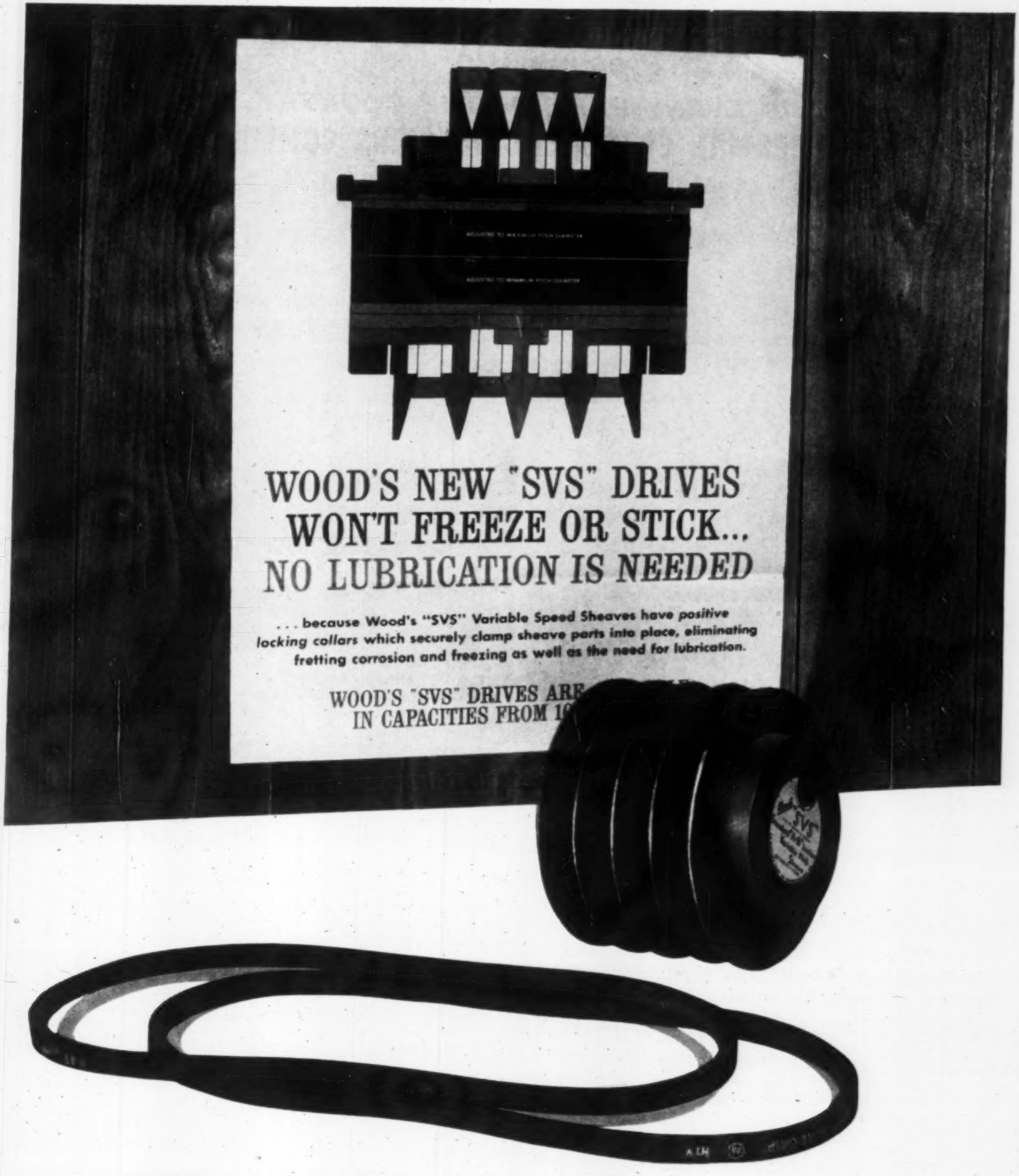
TYPE TM
Bulletin No. 17



TYPE HS
Bulletin No. 14-B

SKIDMORE PUMPS

SKIDMORE CORPORATION, ST. JOSEPH, MICHIGAN



WOOD'S NEW "SVS" DRIVES
WON'T FREEZE OR STICK...
NO LUBRICATION IS *NEEDED*

. . . because Wood's "SVS" Variable Speed Sheaves have *positive locking collars* which securely clamp sheave parts into place, eliminating fretting corrosion and freezing as well as the need for lubrication.

WOOD'S "SVS" DRIVES ARE
IN CAPACITIES FROM 1

Wood's stationary control, variable speed drives, including SVS types, are available in capacities from fractional to over 300 hp using conventional v-belts. Wide range VPS types are available in capacities from 1 to 20 hp.

Write for BULLETIN 6102.

T. B. WOOD'S SONS COMPANY • CHAMBERSBURG, PENNSYLVANIA

ATLANTA • CAMBRIDGE • CHICAGO • CLEVELAND • DALLAS

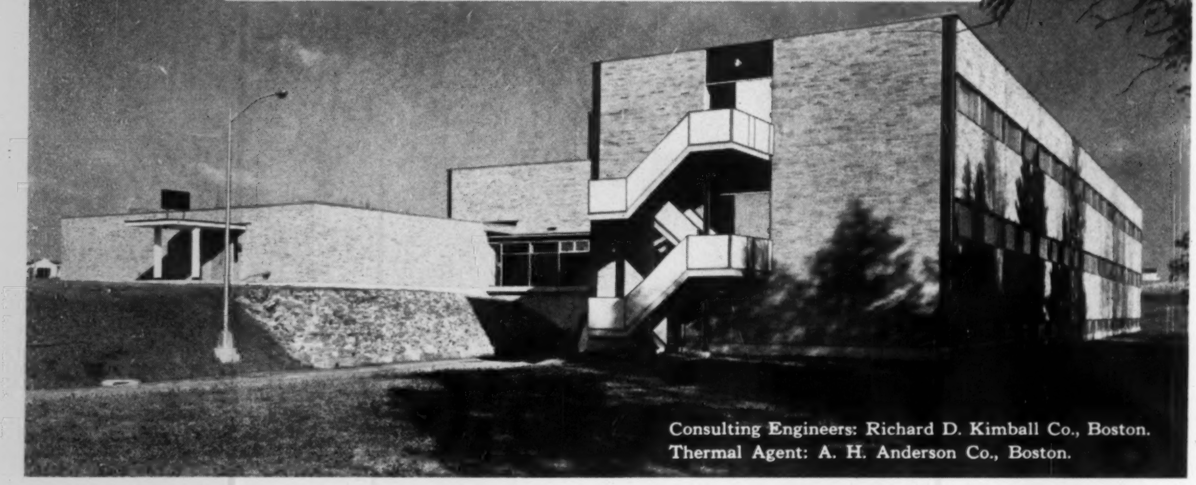
Wood's

SVS/161

At Presque Isle, Maine . . .

AND EVERY PART OF THE COUNTRY . . .

THERMAL EQUIPMENT DELIVERS COMFORT



Consulting Engineers: Richard D. Kimball Co., Boston.
Thermal Agent: A. H. Anderson Co., Boston.

HORIZONTAL CENTRAL PLANT

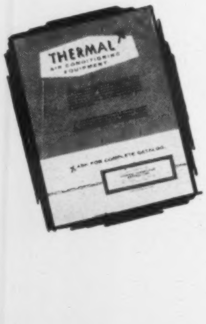
Gould Memorial Hospital in Presque Isle, Maine, uses Thermal units for its dependable air conditioning and ventilating system.

Used in a growing number of hospitals and all types of buildings, from air terminals to zoos, the quality and dependability of Thermal equipment brings comfort to occupants, satisfaction to owners, and confidence to architects and engineers.

The Thermal line of finer air conditioning and ventilating equipment is one of the most comprehensive on the market.

Complete details on Thermal equipment that you can specify with confidence are available.

New! Condensed 6 page, 2 color brochure briefly describes the Thermal line. Write for your copy.



A few of the other hospitals using Thermal equipment:

NAME	LOCATION
Henry County Hospital	Abbeville, Ala.
Jackson Hospital	Montgomery, Ala.
Park View Memorial Hospital	Arlington, Calif.
Jackson Memorial Hospital	Miami, Fla.
Mercy Hospital	Miami, Fla.
Cloverleaf Hospital	Miami, Fla.
Augustana Hospital	Chicago, Ill.
Cushing Memorial Hospital	Leavenworth, Kan.
Our Lady of the Lake Hospital	Baton Rouge, La.
Southern Baptist Hospital	New Orleans, La.
Van Buren Hospital	Van Buren, Maine
Medfield State Hospital	Medfield, Mass.
Midway Hospital	St. Paul, Minn.
Mounds Park Hospital	St. Paul, Minn.
Jefferson Davis Memorial Hospital	Natchez, Miss.
Cedar County Memorial Hospital	Eldorado Springs, Mo.
St. Elizabeth Hospital	Lincoln, Nebraska
Charlotte Memorial Hospital	Charlotte, N. C.
Lea County Hospital	Hobbs, New Mexico
Anadarko Hospital	Anadarko, Okla.
Haskell County Hospital	Stigler, Okla.
Hillcrest Memorial Hospital	Tulsa, Okla.
Columbia Hospital	Pittsburgh, Pa.
Roper Hospital	Charleston, S. C.
Spohn Hospital	Corpus Christi, Texas
Cook Memorial Hospital	Ft. Worth, Texas
Hermann Hospital	Houston, Texas
Memorial Hospital	Houston, Texas
Mercy Hospital	Houston, Texas
Tuberculosis Hospital	Houston, Texas
Institute for Rehabilitation & Research	Houston, Texas

(Plus a number of government operated hospitals)

Quality Products Since 1945

THERMAL ENGINEERING CORPORATION

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HOUSTON 19, TEXAS

AGENTS IN PRINCIPAL CITIES

. . . in Chicago's new Exposition Center

Impressive main entrance to Chicago's Exposition Center, magnificent new mecca for exhibitors and conventioneers. Inset, right, shows one arrangement of the many Dorex filters.

996 DOREX AIR RECOVERY FILTERS SAVE 800 TONS OF AIR CONDITIONING CAPACITY

. . . and provide relief from the irritant-heavy atmosphere of shows, conventions, exhibits

In the new 34 million dollar Exposition Center at McCormick Place, 996 high efficiency Dorex activated carbon filters—the largest installation of its kind in the world—purge recirculated air of irritants and purify it for sanitary re-use in the Center's vast air conditioning system.

But from the Center's profitable-operation point of view, Dorex air recovery is even more important. Serving 350,000 square feet of exhibition space, the filter system will have almost one million cfm recirculated through it . . . representing a saving of 800 tons of air conditioning capacity at an installed cost of approximately $360 per ton, for a total saving of over $300,000! And further tremendous savings in operating costs will be realized!

Thirty years of research, development, and application, plus a systematic replacement service that ensures the continuous effective operation of every installation, make Dorex the best method of AIR RECOVERY and ODOR CONTROL.

Representatives in principal cities.
Write for detailed information.

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dorex®
air recovery

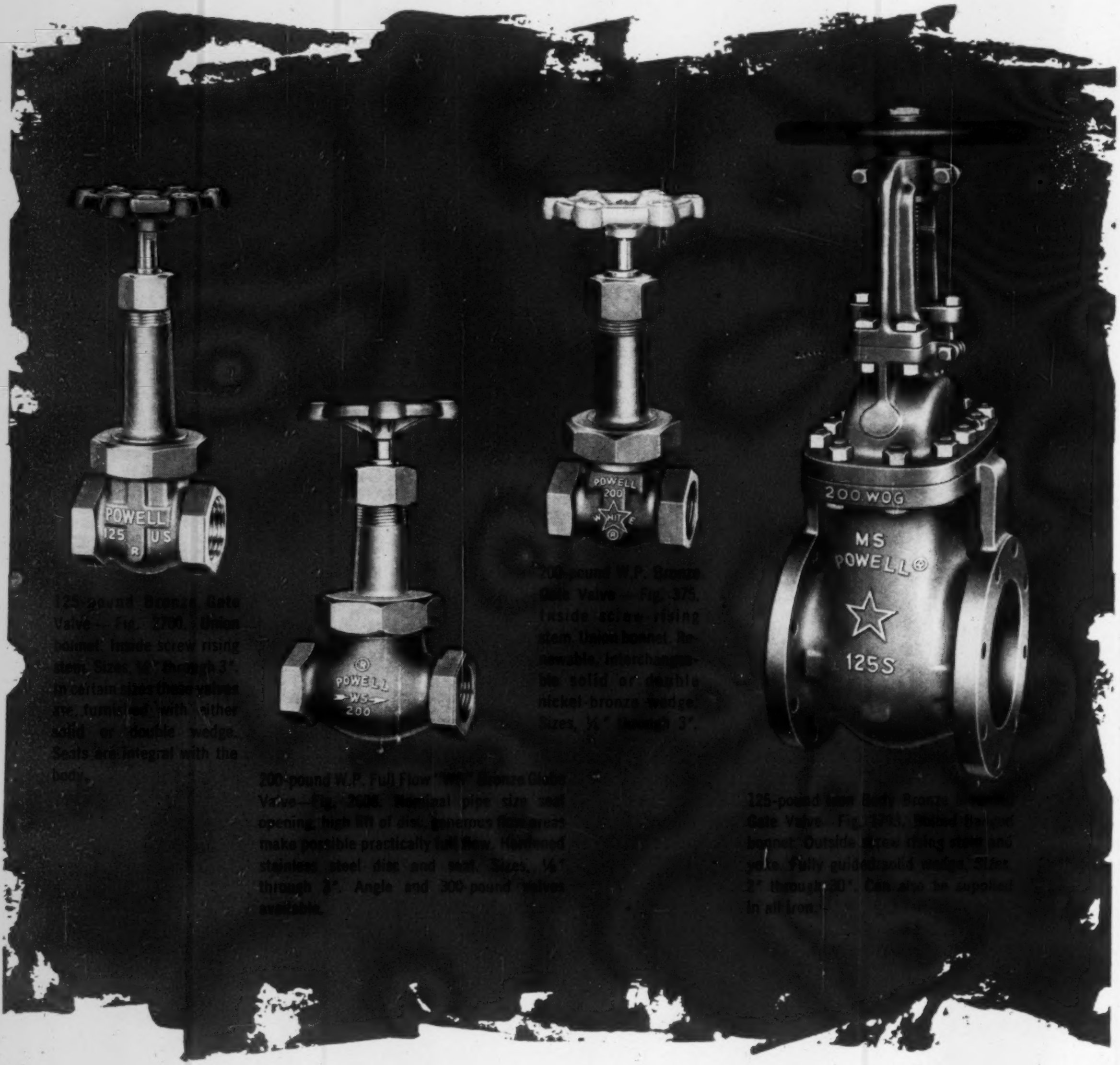
. . . the most experienced professionals in air recovery and purification.

POWELL MAKES IT A SIMPLE MATTER

To find the right valve, just call Powell. It's that simple, since Powell offers the world's largest variety of industrial valves for virtually any flow control problem . . . such as handling water, oil, gas, air, steam and corrosive fluids.

What's more, you don't have to wonder about Powell performance. It's built-in through sound engineering, development, materials and workmanship.

So, remember, finding the right valve can be a simple matter when you specify Powell Valves. For further information, call your nearby Powell Valve Distributor (there's one in every major city), or write us direct.



125-pound Bronze Gate Valve — Fig. 2700. Union bonnet. Inside screw rising stem. Sizes, ¼" through 3". In certain sizes these valves are furnished with either solid or double wedge. Seats are integral with the body.

200-pound W.P. Full Flow "WS" Bronze Globe Valve—Fig. 2606. Nominal pipe size seat opening, high lift of disc, generous flow areas make possible practically full flow. Hardened stainless steel disc and seat. Sizes, ¼" through 3". Angle and 300-pound valves available.

200-pound W.P. Bronze Gate Valve — Fig. 375. Inside screw rising stem. Union bonnet. Renewable, interchangeable solid or double nickel-bronze wedge. Sizes, ¼" through 3".

125-pound Iron Body Bronze Mounted Gate Valve—Fig. [illegible]. Bolted flanged bonnet. Outside screw rising stem and yoke. Fully guided solid wedge. Sizes 2" through 30". Can also be supplied in all iron.

115th year of manufacturing industrial valves for the free world

POWELL DEPENDABLE **VALVES**

THE WM. POWELL COMPANY CINCINNATI 22, OHIO

The Diplomat, completed in 1959, offers a long list of unusual comforts and conveniences, embodying the finest in architectural design, construction, and appointments. Architect: A. H. Salkowitz; Engineer: Charles Wurmfeld; Builder: Irving Warfield; Heating Contractor: Par Plumbing Company

LUXURY APARTMENTS SECURE YEAR-ROUND HEATING COMFORT WITH EASILY INSTALLED WEATHER-COMPENSATING SARCOTHERM HEATING CONTROL SYSTEM

This is the Diplomat, a prestige address in Long Island's Forest Hills. Its Sarcotherm Weather-Compensating Heating Control System provides tenants with comfortable temperatures throughout the heating season, regardless of outside weather. In projects like this, perfection must extend to every area of living comfort, and Sarcotherm systems assure the necessary accuracy and reliability, *with no installation problems.*

Precisely calculated valve orifices, with plates brazed in at the factory, insure proper distribution of sub atmospheric steam, even in mild weather. Sarcotherm Continuous Flow Modulating Steam Control Valves, factory-calibrated, meter steam to provide proper heat by reacting not only to outside temperatures, but to changes in wind velocity and solar radiation. The complete programming operation is handled by a Master Control Panel which automatically regulates cycles for daytime and nighttime operation and quick morning heat-up.

The Diplomat control system was easy to install rapidly, for several good reasons. Sarcotherm supplied custom-made detailed drawings, tagged every component, and keyed every part to the drawings. Sarcotherm engineers provided supervision throughout the job and made final system adjustment through start-up.

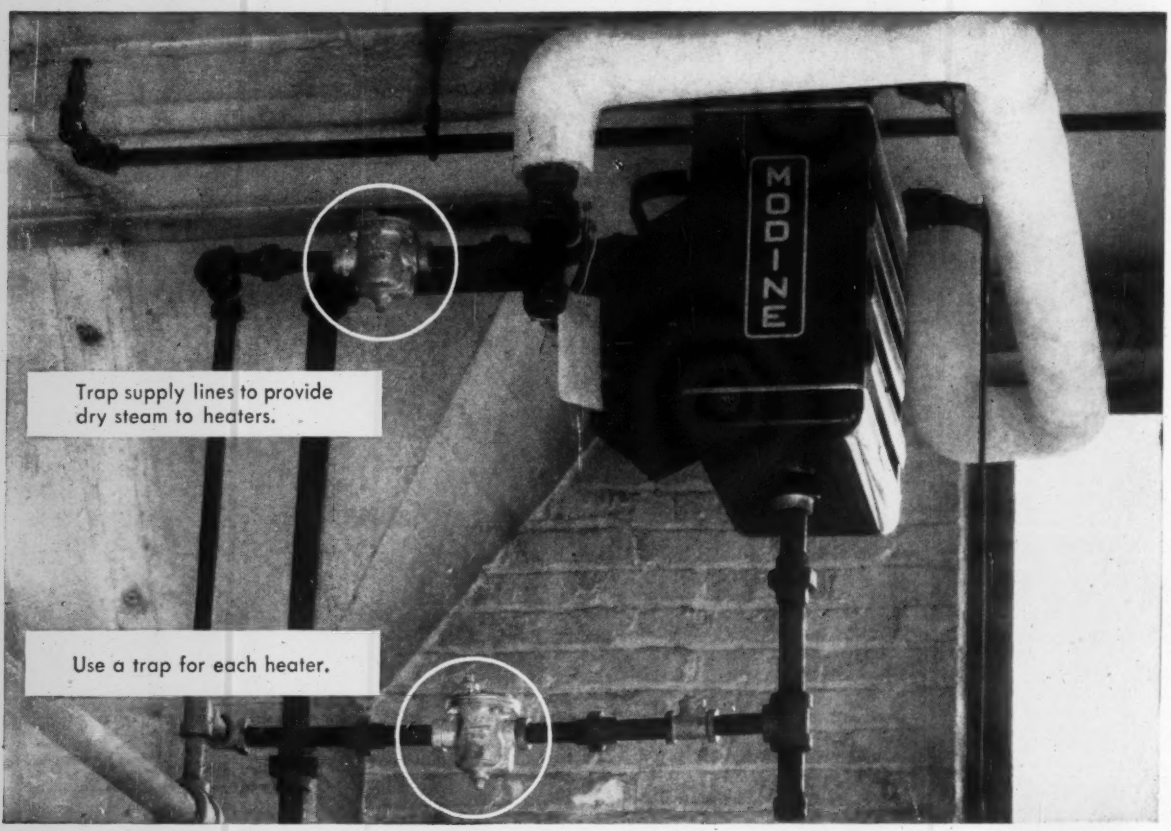
When you call in Sarcotherm on any major heating control problem, you get a custom-planned solution based on wide ranging experience. Sarcotherm takes undivided responsibility for quality components integrated into a reliable control system. It will pay you to deal with Sarcotherm. First step: Write for complete literature.

5790

FOR COMPLETE CONTROL SYSTEM CATALOG write Sarcotherm Controls, Inc., 635 Madison Avenue, New York 22, N.Y.

SARCOTHERM

SARCOTHERM · CONTROLS, INC.,
AN AFFILIATE OF SARCO COMPANY, INC.,
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.


MODINE
Trap supply lines to provide dry steam to heaters.
Use a trap for each heater.

Tips on Trapping Unit Heaters for Full Output and Low Maintenance

• If unit heaters are clean and the steam supply and return lines are adequate, their performance will depend entirely upon the steam trapping. Here are some trapping pointers to insure plenty of heat when it is needed:

1. Trap supply lines to take care of condensate formed by radiation loss.

2. Use one trap for each heater. Two or more heaters drained by a single trap will fail to deliver maximum btu output.

3. Size traps properly. Many a unit heater is handicapped by a trap lacking adequate condensate and *air* handling capacity. The few dollars extra for larger traps insure fast heatup, full output and freedom from coil corrosion.

4. Install traps correctly. Put trap below and close to heater. Install a bypass around the trap if the heater must be kept in operation at all times. A shut-off valve in the discharge line facilitates trap inspection. Use of check valves and strainers is dependent upon piping conditions and the traps used.

5. Protect against PRV failure where freezing could occur. Sometimes heaters supplied with reduced pressure steam are installed where freezing could occur if traps failed to open. In this case select traps that will open at maximun steam supply pressure and still have adequate capacity at reduced pressure.

FREE ON REQUEST—COMPLETE INFORMATION on the above points, diagrams, selection data, tables and additional recommendations are contained in Armstrong Bulletin No. 252. Also includes BTU output ratings for all models of 30 makes of unit heaters. Call your local Armstrong Factory Representative or write direct.

860 Series for low pressure heating service.

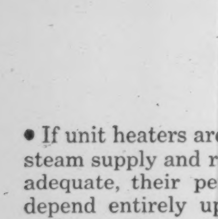
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.

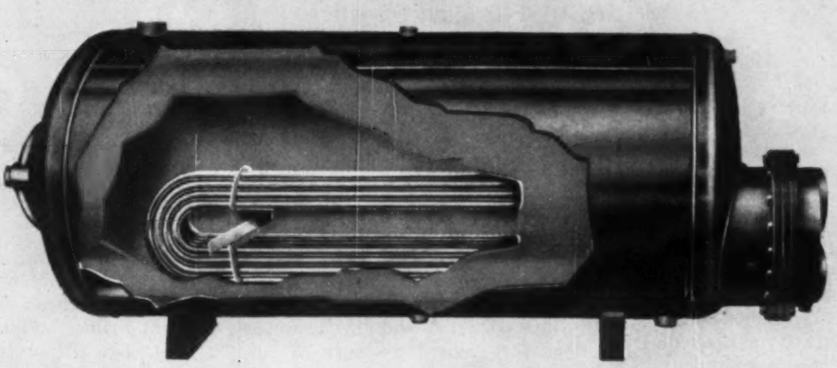


The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS
8746 Maple Street, Three Rivers, Michigan
"See Our Catalog in Sweets Industrial Construction File"

NOW! PRE-KRETE® FACTORY LININGS

Guaranteed



Five Years

UNCONDITIONALLY WITHOUT QUALIFICATION

The Pre-Krete factory-installed lining you specify today will be in perfect condition in 1966 . . . or P-K will repair or replace it free of charge! This new five-year unconditional, *un-prorated* guarantee covers materials and labor. It applies to all factory lined P-K storage water heaters. • After five years? Pre-Krete cures in hot water, gets better as it ages. Chances are it will last almost indefinitely. • A Pre-Krete rust- and corrosion-resistant hydraulic cement lining doubles the life of a plain steel heater, yet costs only slightly more. Special additives make the ¾″ coating extra durable. It doesn't chip, crack or flake even at temperatures up to 900°F. And, there are no weak spots or "holidays", because Pre-Krete is always uniform – a result of precision blending. Maintenance costs, of course, are lowered appreciably. • P-K Pre-Krete lined storage water heaters are economical to buy, install and operate. • Designs are advanced in concept and fabrication techniques meet all ASME specifications. • We'll gladly send you our descriptive catalog and more information. Write Patterson-Kelley Co., Inc., 35 Burson Street, East Stroudsburg, Penna.

Patterson Kelley
Water Heater Division

DON'T COMPARE

insul-fil®

WITH ANY OTHER FILL-TYPE INSULATION!

insul-fil Is A Reinforced Hydrocarbon Fill

There's a big difference — a tremendous difference between Insul-fil and all other fill-type insulations for underground piping. Only Insul-fil has the exclusive patented perlite filler that eliminates flow. Insul-fil installations have proven themselves by standing up under all kinds of conditions where other fill-type insulations have failed.

It is a well-known fact that bitumens will flow when subjected to heat or pressure. Even hard bitumens which do not flow will crack when cool.

But Insul-fil, with its perlite filler, is completely different and infinitely more efficient in thermal stability and insulation value. It provides greater structural stability even when used at maximum temperatures.

Perlite Aggregate In INSUL-FIL Makes All The Difference

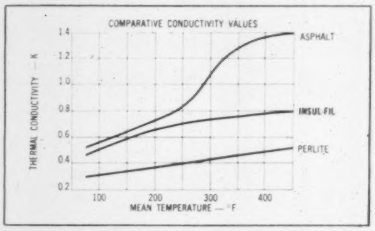
A unique combination of high softening point petroleum asphalt blended with coated inorganic perlite, Insul-fil provides far greater insulation value than any unfilled asphalt. Perlite, made from a volcanic rock which has been crushed, screened and expanded at a very high temperature, is composed of glass-like beads or perls. Each perl contains a maze of "sealed" dead air cells which give Insul-fil its light density and high insulation value. The patented process, developed for waterproofing the perlite, makes Insul-fil far superior in water resistance. In addition, another exclusive Insul-fil development is priming of pipe with Primer #7591, which provides continuous adhesion of Insul-fil to pipe, speeds consolidation, and gives positive protection against corrosion by galvanic action.

INSUL-FIL Most Effective Of All Fill-Type Insulations For Underground Piping

Field installations and all types of conclusive testing prove Insul-fil by far more effective in insulation value.

After Insul-fil is installed and heat is introduced into the lines, the Insul-fil is formed into a homogeneous consolidated mass consisting of a small plastic area of varying thickness at the pipe wall, an accompanying sintered area, and in the lower temperature range an area of unsintered material immediately adjacent to the soil.

Unlike the 100% asphalts, Insul-fil does not crack and craze from thermal shock when the heat is turned on or off and therefore does not provide access for water to the pipe. It is during the critical shut down period of spring and summer when cold pipe is especially subject to corrosion that Insul-fil is so highly water resistant.



Yes! There's a big difference between Insul-fil and all other fill-type insulations for underground piping.

INSUL-FIL Most Economical Of All Fill-Type Insulations For Underground Piping

1 — Comparative cost analysis between Insul-fil and other types of underground conduit proves Insul-fil in place costs substantially less.

2 — Insul-fil weighs 30% less than other materials, and therefore costs less to ship, less to handle, less to install.

3 — Insul-fil is simple to install. The material is all in one package — 2 cubic feet weighing approx. 57 lbs. Insul-fil Primer supplied free of cost is applied to the surface of the pipe. The loose Insul-fil is poured from the bag around the piping to be insulated, well prodded and tamped, then the trench is backfilled. As simple as that. Heat introduced into the system forms the conduit. Thus labor for installing Insul-fil requires no special skill. The application is a simple, one trade operation.

Insul-fil keeps on saving you money, with its effective control of heat loss and pipe corrosion, eliminating maintenance. Field changes in the installation of Insul-fil underground systems can be made easily, without changes in the material or its application.

Yes! There's a big difference between Insul-fil and all other fill-type insulations for underground piping.

FREE: 40-page Technical Data Book, complete with engineering drawings, heat loss curves, and installation specifications.

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DIVISION OF: **MIRACLE ADHESIVES CORPORATION**
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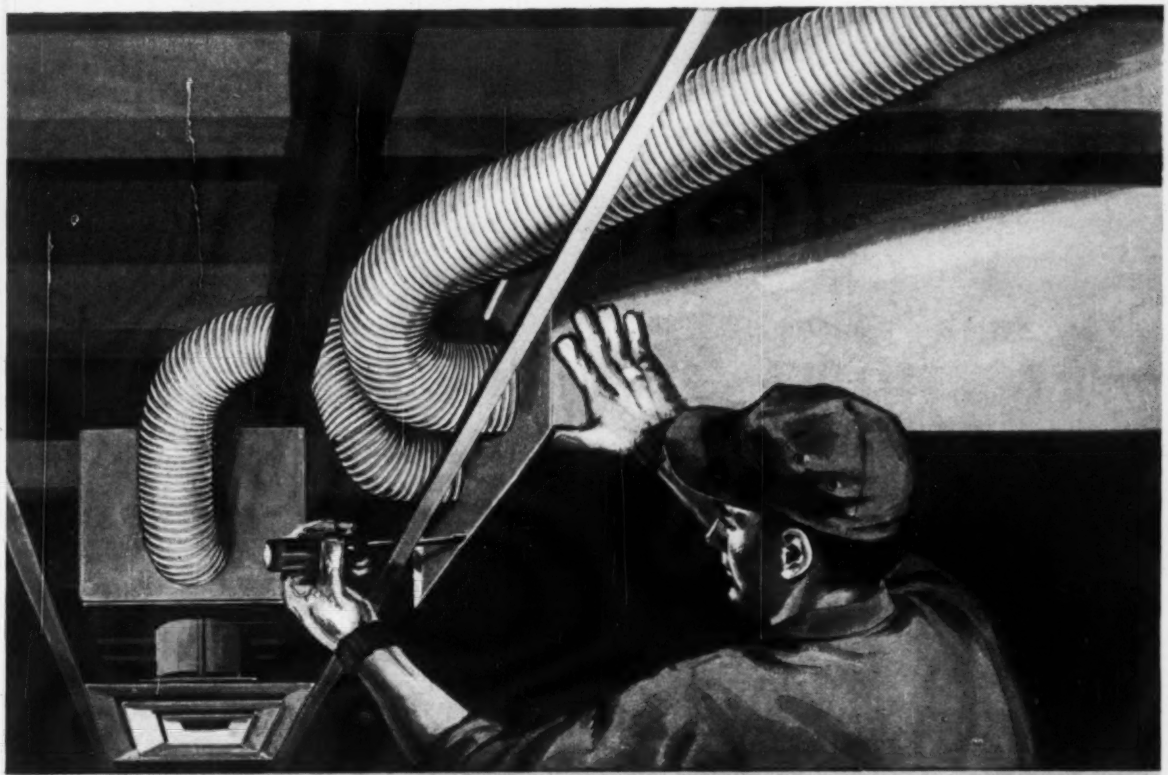

"Super-Flex" Acme-Hamilton Air Conditioning Hose

Acme-Hamilton Manufacturing Corporation the most progressive mechanical rubber goods manufacturer today now brings you "Super-Flex" Air Conditioning hose. A Flexible duct designed for general air conditioning use, this new hose is made of a flame-proofed fabric, neoprene impregnated and hard vinyl coated. A Galvanized coated reinforcement of high tensile steel wire, permits long bends without sagging. Double ply construction provides extra durability.

Made to meet NBFU standards for flexible ducting, Pamphlet 90A. Improved design reduces friction loss and improved noise dampening. Available in ten foot lengths, up to 6 inch. Larger sizes available on special order. Write for more information and samples today about this amazing new hose. Dept. MK-AC-8. Agents inquiries invited.

Acme/Hamilton
MANUFACTURING CORPORATION, TRENTON 3, N. J.
Industrial and Automotive Rubber Products Since 1870

ATLANTA • CHICAGO • DETROIT • HOUSTON • SAN FRANCISCO • INDIANAPOLIS
NEW YORK • SEATTLE • MILWAUKEE • PITTSBURGH • SALT LAKE CITY • LOS ANGELES

Check the Refrigerant at a Glance...

with a **SPORLAN** *See•All*

the Moisture and Liquid indicator with the single dot that shows how dry the refrigerant is... and the full view sight glass that lets you see if the system is fully charged.

Check these See•All advantages too...

One indicator with the same color change for Refrigerants 12, 22, 40 and 500. Color change points for each refrigerant reliably and accurately calibrated in parts per million of moisture content. Color changes are reversible and easily distinguished...dark green indicates dry, and bright yellow wet. The largest, crystal clear, full view sight glass. Color indicator protected from discoloration and dirt in the system. Disassembly not required for installation. Double gasket at sight glass assures a positive leakproof joint. Double duty plastic cap keeps dirt and curiosity out. By-pass kits available for economical installation on large liquid lines.

Get Peak Performance on every installation . . . make Sporlan See•Alls a must on your next order. See your Sporlan Wholesaler and ask him to show you the See•All line, or write for bulletin 70-10.

7/8" and 1 1/8" ODF sweat models now available

SPORLAN VALVE COMPANY
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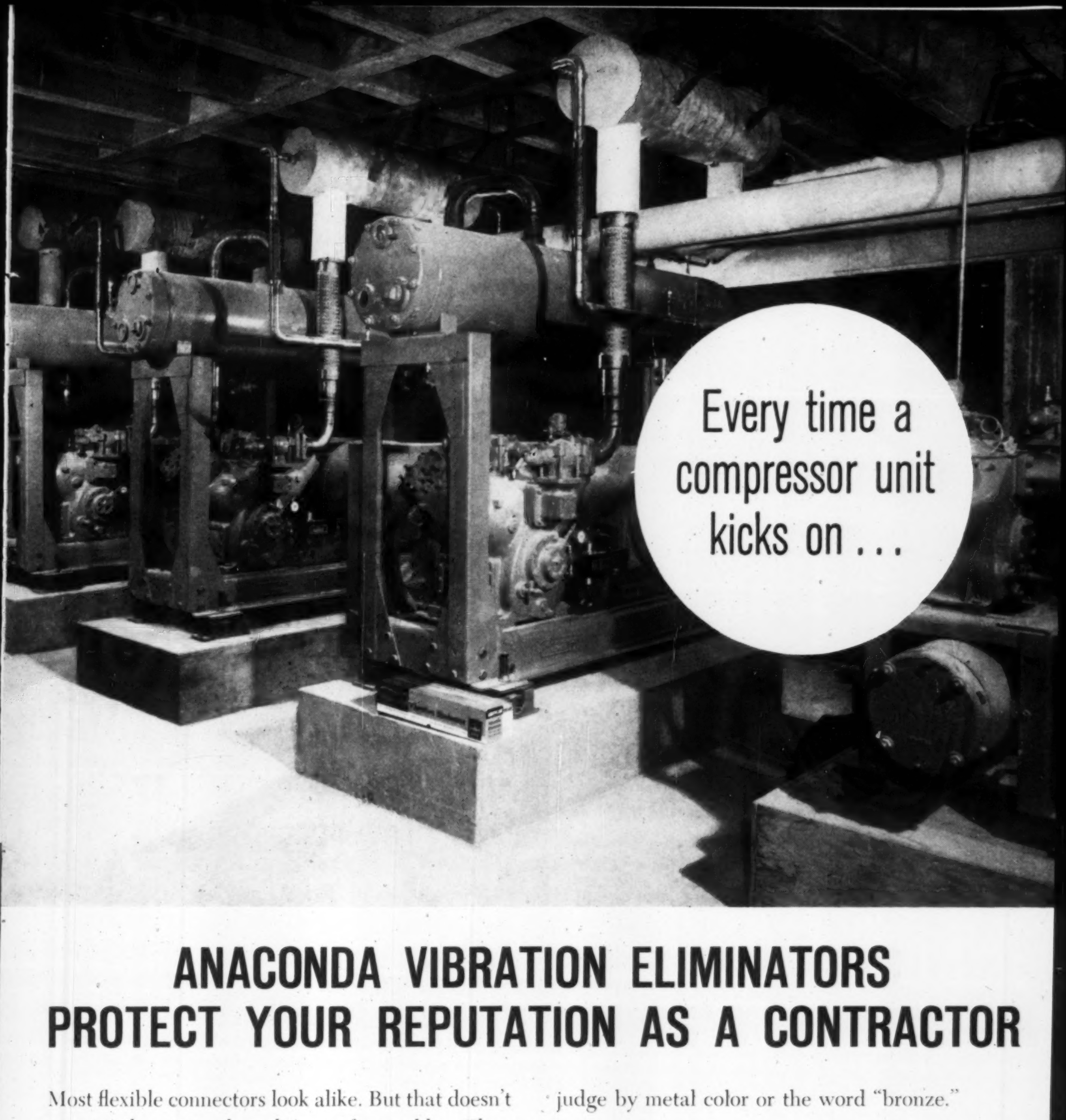


ANACONDA VIBRATION ELIMINATORS PROTECT YOUR REPUTATION AS A CONTRACTOR

Most flexible connectors look alike. But that doesn't necessarily mean that they perform alike. They don't.

For the tough job of controlling vibration in air conditioning and refrigeration systems, Anaconda Vibration Eliminators are made of *true tin bronze*. Tin bronze provides the tensile and fatigue strength needed—soaking up high stresses for millions of cycles.

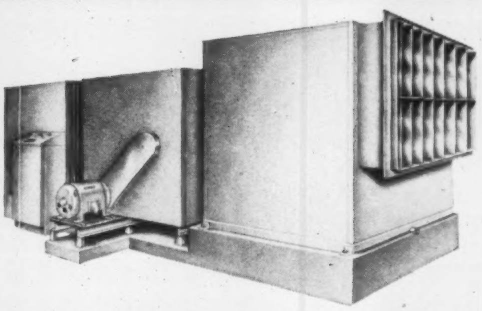
There are copper-zinc alloys, often misnamed bronzes, which have nowhere the strength and fatigue properties of true tin bronzes. And you can't judge by metal color or the word "bronze."

So, to protect your investment, always insist on Anaconda VE's and true tin bronze! Look for the name "Anaconda" right on the ferrule. VE's are recognized by Underwriters' Laboratories, Inc., under File SA2585. For a descriptive folder, write: Anaconda Metal Hose, P.O. Box 791, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

61159

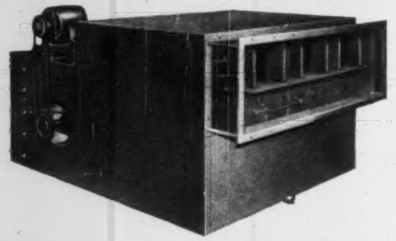
ANACONDA® VE's
IBRATION
LIMINATORS

HIGH-PRESSURE



'BUFFALO' TYPE PCHB ZONE CONTROL CABINETS

For multi-zone or dual-duct high-pressure air conditioning systems up to 8" w.g., they incorporate all features of Type PCB Cabinets plus efficient type BL Fan Section, vertical or horizontal discharge models to meet your space requirements. No need for an expensive discharge elbow. Flexible neoprene connection isolates fan section.



'BUFFALO' TYPE PCB ZONE CONTROL CABINETS

Designed for your low pressure requirements, they feature mixed flow, backward curved type fans for stable performance characteristics and vibration-free operation. Unique coil section with angular coil mounting provides maximum coil face area within minimum headroom and length. Write today for Bulletin AC-220.

LOW-PRESSURE

'BUFFALO' OFFERS YOU BOTH IN QUALITY ZONE CONDITIONING

Here's a selection of proven zone conditioning cabinets to meet the pressure requirements of all your systems! Both have quality 'Buffalo' features available in no other cabinets:

- The famous, exclusive 'Buffalo' backward curved bladed BL Fan for full stability across the range with maximum efficiency and low noise level.
- Zone openings individually factory-sized for correct CFM distribution—no worry about sizing problems on the job—heavy-gauge dampers, stainless steel blade journals.

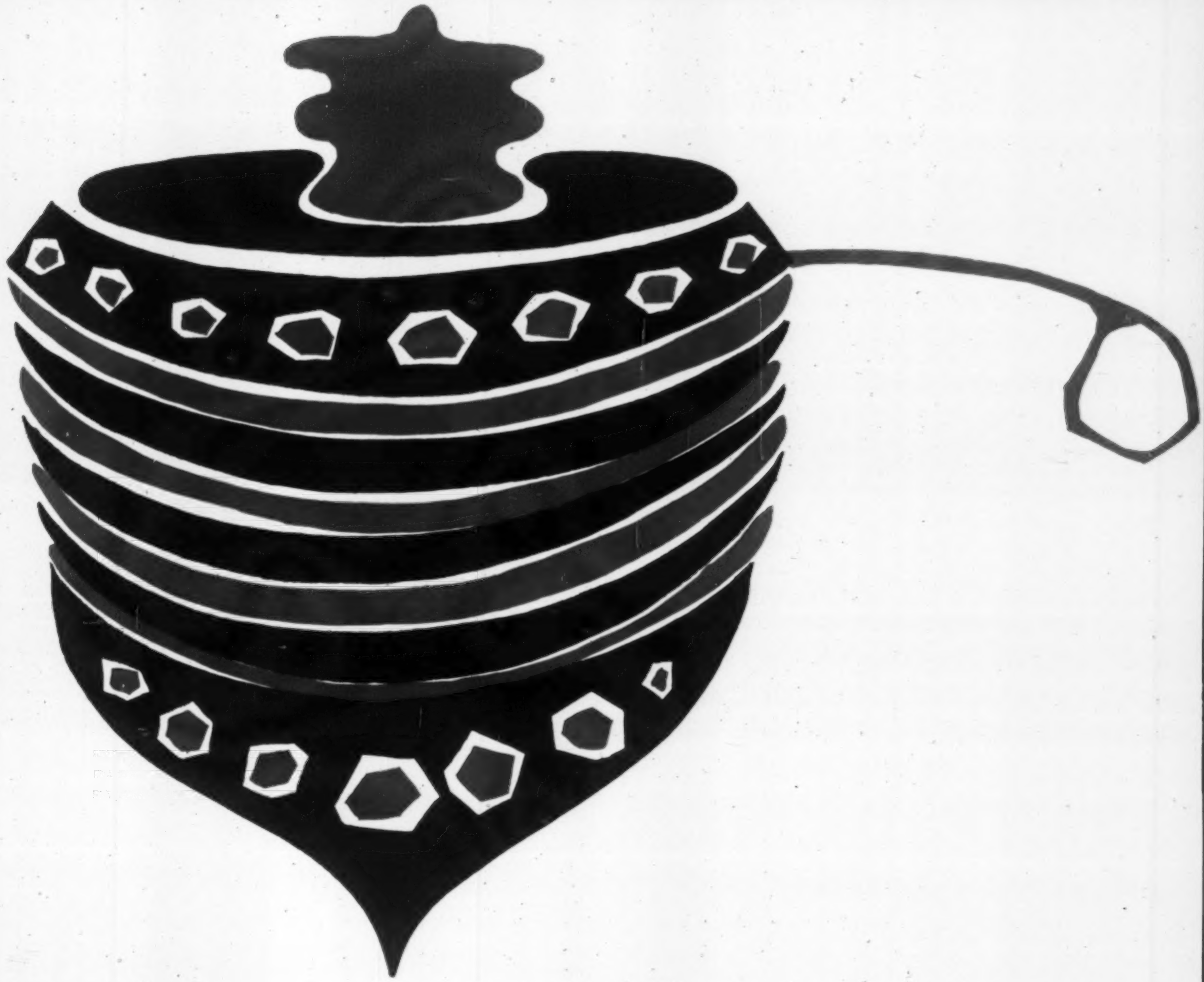
AIR HANDLING DIVISION
BUFFALO FORGE COMPANY
Buffalo, New York
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

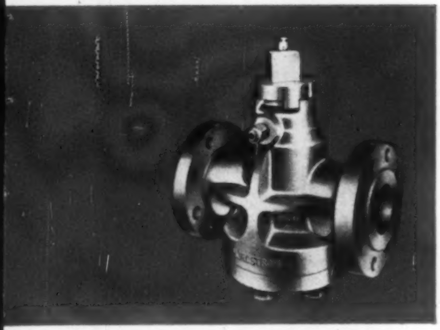
'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.





easy to turn: The longest time in the world can be the time it takes to close a valve . . . when you have to close it in a hurry. The sure, easy quarter turn closure of Rockwell-Nordstrom valves saves seconds, even minutes. And you'll save hours of maintenance time on seat replacement with the Rockwell-Nordstrom's sealant system, which replaces the valve's seat from outside. The longer life of these valves—six, eight, even ten times ordinary types—saves days of replacement labor. Add up these times, multiply by the valves in your plant, then again by your labor rate: the result may amaze you. We'll be happy to send you complete information.

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Canadian Valve Licensee:
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Rockwell International, S.A.
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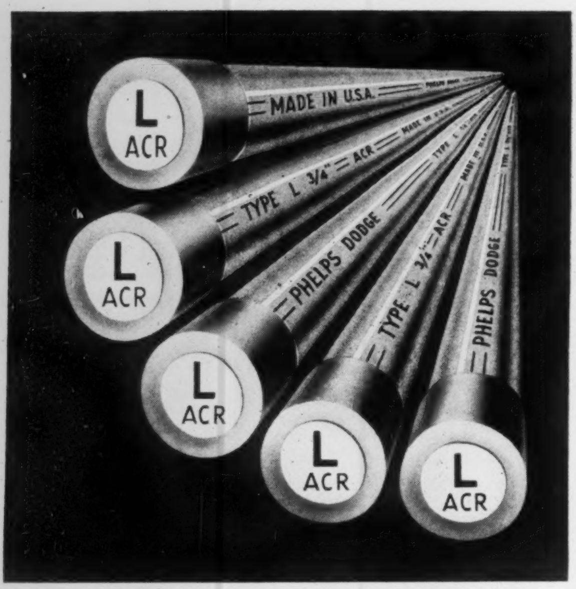
The Famous Mine-to-Market Quality Line!

1 **FINEST QUALITY CONTROL.** Phelps Dodge refrigeration tube is carefully controlled for quality throughout fabrication, rigorously tested before being packaged to assure finest tube properties and lasting quality in service.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TYPE L 3/4" ACR
PHELPS DODGE
TYPE L 3/4" ACR
PHELPS DODGE
L ACR

2 **COLOR-CODED ACR TUBE.** Phelps Dodge ACR tube is specially cleaned for refrigeration use. Extra-long coded end caps are your assurance of factory-clean tube at job site. Tube is color coded "ACR" for your protection.

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COPPER REFRIGERATION TUBE
DEHYDRATED AND ENDS SEALED
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PHELPS DODGE COPPER PRODUCTS CORPORATION
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3 **NEW P-D PAK CARTON.** Reel-type design of convenient new carton allows tube to be rolled or paid out quickly on job. Color-coded identification tape seals carton for protection, makes opening easy.

Quality tube sold the quality way—through authorized refrigeration wholesalers!

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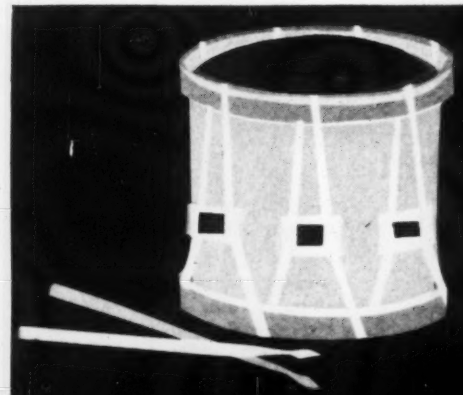
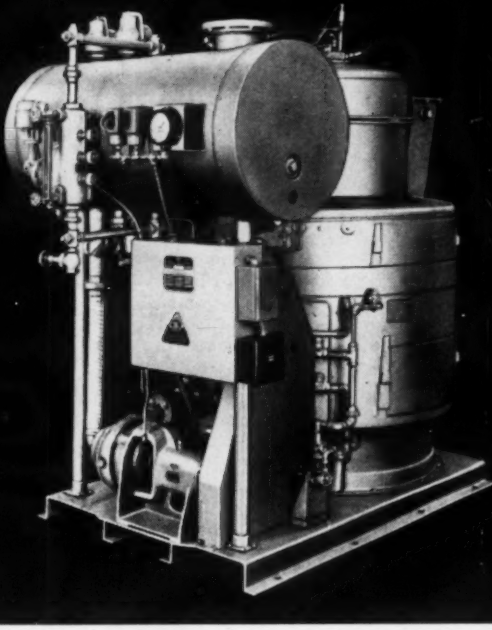


THIS DRUM IS FOR MUSIC...



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Vapor DRUM MODULĀTIC water tube boiler

World's Most Compact Heat and Power Package

200 BHP in only 40 sq. ft.

This pocket-sized power package hits the right note with engineers everywhere. It's compact, efficient...takes only 5' x 8' of floor space. Costs less to install...delivered completely assembled, wired, pre-tested; needs no special foundation, fits through plant doors, can be installed in any unused corner or aisle. Costs less to operate...modulating controls produce steam only "on demand," save fuel. Full steam pressure in 5 minutes from cold start. Ends early-morning shift to fire-up. Fully automatic, push-button operation. Most flexible...multiple-unit installations meet widely-varying, or peak-load steam requirements. Single, coordinating control cuts individual units on or off as steam demand varies. Easiest to maintain...all parts are readily accessible. Sizes: 20 to 200 hp; 0-15, 5-150 psi steam pressure; 670,000 6,690,000 btu/hr. Burns oil, gas, or both fuels. Meets all codes.

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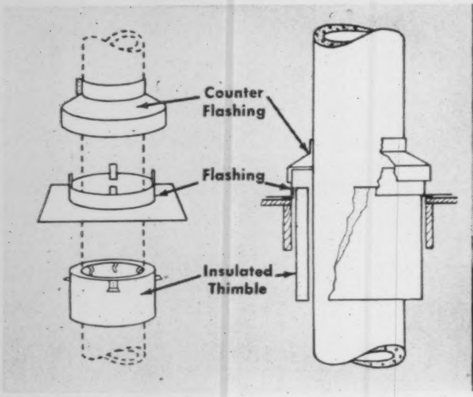
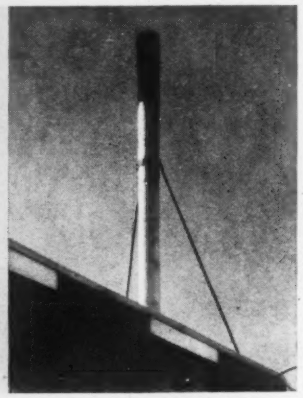
Industrial Stacks

Solving Industrial Stack Problems

New insulated thimble simplifies the design of Van-Packer stack installation





Details of flashing assembly for Underwriters' Laboratories listed installation of Van-Packer Model HT Industrial Stack. Insulated thimble installs at zero-inches clearance to combustibles at roof opening. In sizes for 8 Van-Packer diameters.

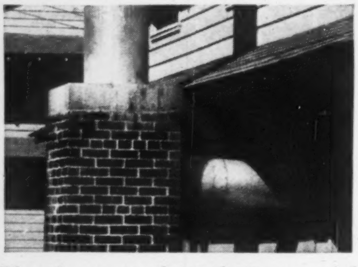
Underwriters' Laboratories, Inc.
®
INSPECTED
Van-Packer Model HT Smokestack

A new insulated thimble and new flashing and counter flashing for Van-Packer factory-built refractory industrial stacks now let you design indoor installations with far less clearance to combustibles than previously required at the roof for a UL-listed installation.

The new components have earned a new Underwriters' Laboratories listing for the Van-Packer Model HT stack — the only UL-listed stack for commercial and industrial incinerators, boilers and furnaces. The insulated thimble installs at zero-inches clearance to combustibles, reducing actual clearance between the stack section and combustible roof from the 18" previously required by Underwriters' Laboratories to 3 inches. In non-combustible construction the thimble is not required because only a 4" clearance is necessary.

The new insulated thimble, flashing and counter flashing are available in appropriate sizes for each of the eight inner diameters in which the Van-Packer stack is offered: 10, 12, 15, 18, 21, 24, 30 and 36 inches. The new components may also be used with the Van-Packer Model BF Stack (not UL-listed). Both models are factory-built in 3-foot cylindrical refractory sections encased in aluminized steel. They can be installed inside or outside on concrete or brick pier foundations, or they can be floor-supported, wall-supported, or superimposed directly on the incinerator or boiler. Van-Packer stacks cost about the same as steel stacks for comparable applications, yet outlast steel an average of three times. The stack provides high draft and requires no painting.

Van-Packer stack section makes ideal breeching for any stack



There's no need to design special breechings for Van-Packer Industrial Stack installations — or for use with any other type of stack. In those cases where the stack is not superimposed directly on the boiler or incinerator, simply specify that the breeching is to be made with a Van-Packer stack section.

Van-Packer Model HT tee sections have a refractory projection for the breeching connection, with the opening equal to the inner diameter of the stack. A Van-Packer straight section with equal I.D. is easily joined to the projection to complete the breeching. The stack and breeching withstand temperatures up to 1800°F, or up to 2000°F for occasional brief periods of forced firing. Breechings for other Van-Packer stack models may be similarly made.

For full data on Van-Packer Stacks, write for Bulletin IS-49.

For residential use, specify the Van-Packer all-fuel chimney

Here's a low-cost, factory-built tile lined residential chimney that's safe and attractive. Specify either metal or asbestos-cement housing with embossed brick design. Choice of four non-fade brick colors: red, white, buff and gray. Factory-built 2-foot flue sections have ⅝-inch fire clay tile liner, 3-inch vermiculite-concrete insulating wall, and asbestos-cement outer jacket. Van-Packer chimney is UL-listed for all fuels, is safe for incinerators. Write for Bulletin RS-1.

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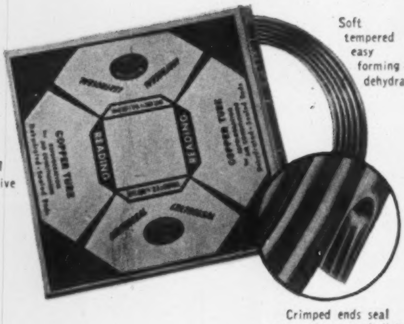

Soft tempered easy forming — dehydrated
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Ideal in

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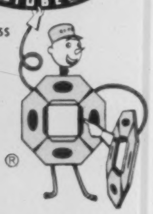

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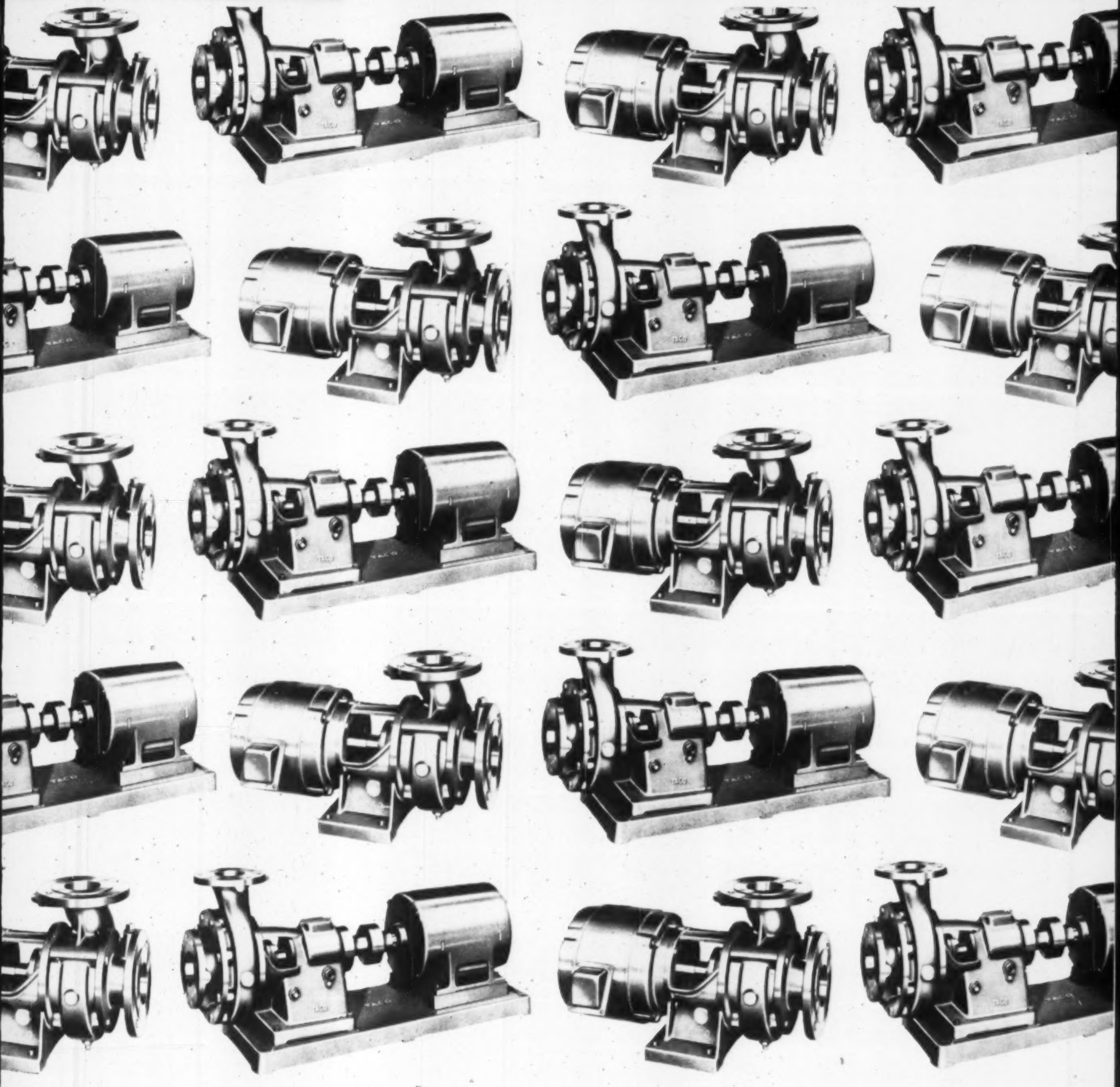

TACO Stocks your Custom-Built Pumps!

That's right. By specifying any *standard* TACO "LP" pump, with its many options, you can actually order a custom-designed, single stage centrifugal pump to precisely meet your requirements!

For Hospital applications, for example, specify any standard "LP" with sleeve bearings and quiet motor. For industrial applications merely specify the *same* "LP" with ball bearings and a regular motor.

And, just as easily, you can specify an "LP", base-mounted or close-coupled . . . with mechanical seals or stuffing boxes, with or without cooling jackets . . . shafts or shaft sleeves in stainless steel and so on. What's more, every "LP" provides many extras, such as advanced design throttle bushing, oil slinger ring lubrication, center-line discharge and many more. Get complete specifications . . . specify "LP". All products in the broad TACO line are "efficiency engineered" to provide maximum performance and economy on all your installations. Write Taco Heaters, Incorporated, 1160 Cranston Street, Cranston 9, R. I.

Taco

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Complete ductwork system of new Humble Oil Building is . . .

GUARDED BY GALVANIZED STEEL

When this handsome Humble Oil office building in Houston, Texas, is finished in 1962, it will be the tallest building west of the Mississippi River. All 44 floors will be served by galvanized steel ductwork. That's 700 tons of skin-tight zinc-coated steel—a combination of tough durability and excellent corrosion protection with the broadest economy east *or* west of the Mississippi River. Galvanized steel's economy starts with fabrication, continues with erection and installation and is perpetuated in what little maintenance is required after that.

WEIRKOTE® IN PARTICULAR!—That's the choice of Mr. Harold W. Looney, owner of Looney's of Texas, Inc., sheet metal contractor, for all 700 tons of ductwork in this new building. To the inherent strength of steel—to its economy, versatility and advantageously low expansion/contraction rate—Weirkote adds flawless fabrication and long-lasting corrosion protection. Chip-free, crack-free, peel-free Weirkote is manufactured by two National Steel divisions, Weirton Steel and Midwest Steel. Write Weirton Steel Company, Weirton, West Virginia, for further details.

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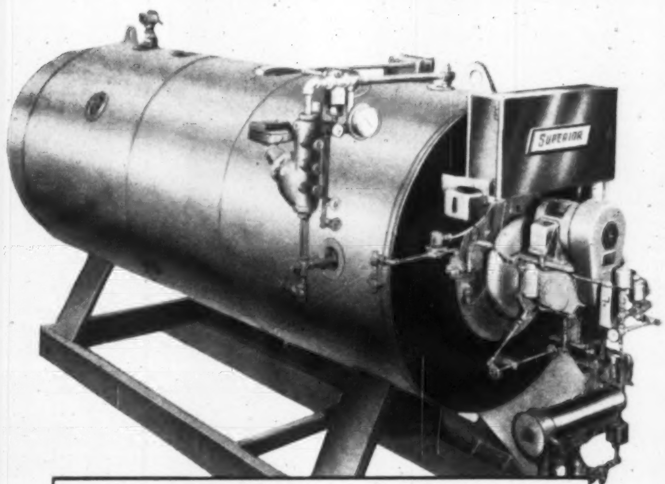
Don't settle for less than SUPERIOR®

when YOU buy a boiler



Specify all these features now and avoid wishing you had later

Because boilers are generally purchased or specified by executives acting for their corporations, or consulting engineers who are acting for their clients; the men who buy boilers seldom sign the checks which pay for them.

To these men, upon whom falls the responsibility of spending someone else's money, Superior's many engineered features make the purchase of a boiler a sound investment.

① ***Complete Package — Unit Responsibility***

If you settle for less, you may find yourself playing that old army game known as "passing the buck".

② ***Shipped Complete after Fire-Testing***

The tests of a prototype won't prove the performance of YOUR unit . . . and factory-fire-testing "gets the bugs out" at the factory . . . not in your boiler room.

③ ***More than 80% Thermal Efficiency***

You'll be pleasantly reminded of its efficiency and operating economy every time you pay a fuel bill.

④ ***Full 5 Sq. Ft. of Heating Surface per Bhp.***

Ample heating surface combined with 4-pass design produces those high efficiencies without strain.

⑤ ***Integrated Induced Draft***

It's quieter. It's safer. It's cleaner. Instead of forcing soot into your boiler room, it sucks it out.

⑥ ***Simple Installation is Economical***

Requires no tall expensive chimney, no special foundation other than a floor which will support its weight.

⑦ ***Heavy-duty, Rugged Construction***

Check its weight. It's heavier . . . built for that long-lived operation which generates owner satisfaction.

⑧ ***Built to fire Oil, Gas, or Both***

Designed for any liquid or gaseous fuel, and supplied with burners and controls to suit your own operations.

⑨ ***Ideal for Battery Operation***

Where load demand fluctuates widely, battery installations provide wide flexibility at maximum operating economy.

For condensed data describing the World's Most Complete Line of Packaged Boilers, write today for Catalog S 14

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For buying Ucon® Refrigerants in 125-lb. and 145-lb. cylinders

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up on refrigerants
cylinders

BY POPULAR DEMAND...

The Ucon Ike SHIRT Premium Offer Has Been Extended One Month

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See Your Wholesaler For The Details!

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the brass dust cap on the valve cylinder of Ucon Refrigerants (125-lb. nders of Ucon Refrigerant 22, too), you'll find a Ucon Ike Seal. Simply mail two of these seals, together with your name, and the name of your wholesaler on your company letterhead to: Ucon Ike, P.O. Box 1010, Grand

ation, New York 17, N. Y. Applications must postmarked no later than April 30th, and no earlier than April 1, 1961. And don't forget to include your shirt size! (Small, Medium, Large or Extra-Large.) While you're at it, any comments you'd care to include on the Ucon Refrigerants line will be most welcome. As soon as we hear from you, your Ucon Ike Sport Shirt will be rushed on its way.

*Remember—this offer is good from April 1st through April 30th only!

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Specify 145-lb. Cylinders of Ucon® Refrigerants

a UNION CARBIDE product
Ucon® refrigerants

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Exclusive Sales Agents to Air Conditioning and Refrigeration Wholesalers
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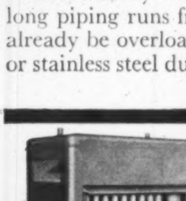
Ucon is a registered trade mark of Union Carbide Corporation

where to use gas-fired heaters in plants

Free from Reznor: Our just published handbook, "Industrial Applications of Direct Gas-Fired Heaters," tells all about the profitable use of Reznor heaters in manufacturing plants.

Use it to find out the many advantages—and economies, too—of using Reznor unit heaters for comfort heating of work or storage areas. For example, you can spot the heaters exactly where heat is needed, without installing long piping runs from a remote central boiler that may already be overloaded. You can use Reznor Aluminized or stainless steel duct furnaces for tempering make-up air or heating process air. Or use them in year-round heating and cooling systems. (Reznor duct furnaces are A.G.A.-approved for downstream applications.)

Among other subjects covered: How to blanket shipping doors, how to install heaters 40 ft. high to clear crane-ways; how to use Reznor heaters for stand-by operation on liquefied petroleum gas—with city gas as standard fuel. Published by Reznor, the world's largest manufacturer of gas unit heaters, the handbook is yours free. Mail the coupon—or, call your Reznor distributor or district office, listed in the Yellow Pages under "Heaters—Unit."



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ALCO'S *New* P.O.S.

CHILLER CONTROL

THERMO® EXPANSION VALVE

Alco's New P. O. S. Valve
is engineered with the
Solenoid Pilot Stop Valve as an
integral part of the P. O. Valve.

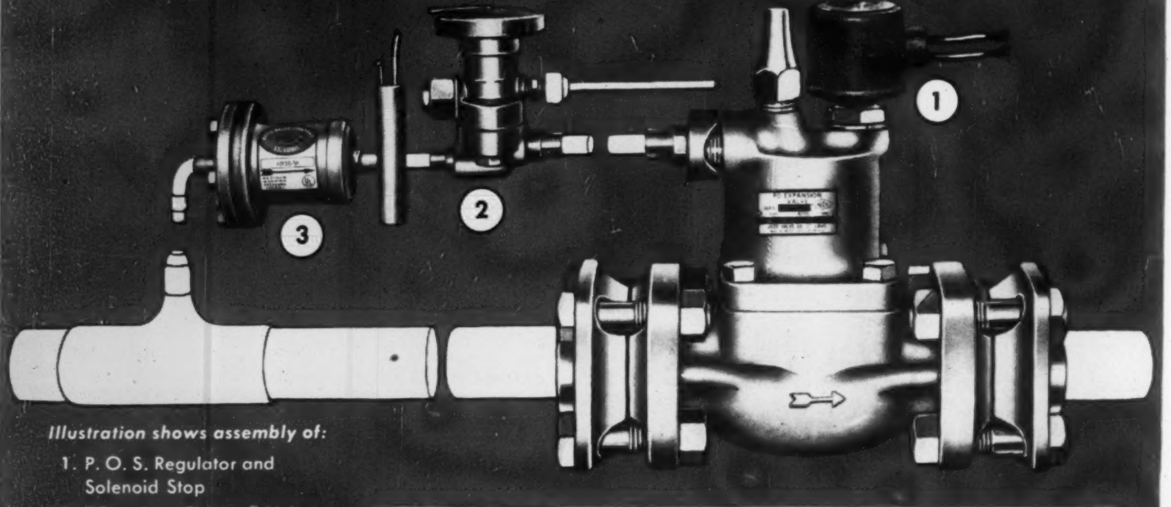

Illustration shows assembly of:

1. P. O. S. Regulator and Solenoid Stop
2. TCL—Pilot Thermo® Valve
3. H290—Line Strainer

ALCO P. O. S. VALVE ASSEMBLY—designed and engineered specifically for wide load applications—particularly recommended for refrigeration systems having capacity reduction —the ALCO SOLENOID PILOT STOP VALVE insures positive liquid "Shut-off."

ALCO PILOT OPERATED THERMO EXPANSION VALVES—give a positive control to 15% of nominal capacity with minimum superheat.

ALCO LIQUID LINE STRAINERS—insure positive protection of working parts from solder and dirt.

Capacities: 20 to 200 tons
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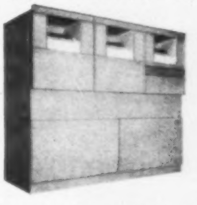
which man specified Typhoon ?

That complacent looking fellow on top of the pole. He knows Typhoon will deliver beyond specifications—guaranteeing satisfaction. With the addition of 28 new units to its 1961 Line, Typhoon offers the industry's broadest, biggest, most versatile group of packaged air conditioners, furnaces and heat pumps. Typhoon economy begins with its mass produced components, which can be custom-assembled to your order to meet any unusual requirement...**at little or no extra cost.** Typhoon quality begins with Power Reserve—superior components and oversize parts to deliver beyond rated capacities. Each Typhoon unit is built to take extreme weather conditions and sudden severe temperature changes without strain or breakdown. The 28 new units include nine heat pumps, three air handlers, three air cooled remote condensing units, three air cooled condensers, and ten self-contained package units. **For complete satisfaction,** specify Typhoon. It suits every need in air or water cooled units; ceiling, floor or roof mounted units; units that heat and cool or cool only — in capacities from 3 to 75 tons. Write us for complete product literature.



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Control of thermal expansion in piping

Flexible support can prevent destructive stresses in high temperature piping

Heat 100 linear feet of alloy steel pipe to 1000°F, and it will expand approximately 9 inches! When this thermal expansion takes place in a piping system, the resultant forces — if uncontrolled — can do incalculable harm.

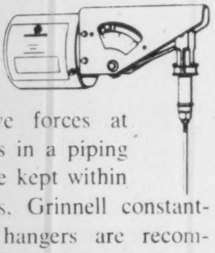
Helical coil springs

Using helical coil springs to compensate for thermal expansion in piping is now common practice. However, designing or selecting flexible supports is often done haphazardly. In fact, any specifications covering the support of important high temperature piping simply say "spring hangers shall be provided." But it is not enough to merely admit that thermal expansion may be dangerous.

Safety of entire system at stake

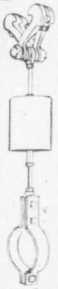
Careful study must be given to the design and selection of spring supports which will maintain a balanced piping system. If not, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system. Today, you're often confronted with 8–9–even 10 inches of thermal deflection. That's why flexible support for piping in all positions of travel is a definite "must"!

Constant-support hangers



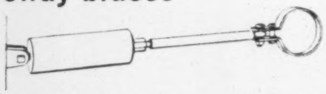
Where reactive forces at terminal points in a piping system must be kept within specified limits, Grinnell constant-support type hangers are recommended. They are designed to provide uniform supporting force equal to the pipe load throughout the range of thermal movement. Constant-support hangers should be used at superheater outlets, turbine connections, and on high temperature and other critical lines.

Variable spring hangers



When pipe lines are subject to vertical movement — and restrictive conditions do not require a constant-support hanger — variable spring hangers are recommended. They should be designed for a maximum variation in supporting effect of 25% for the total travel resulting from thermal conditions.

Vibration control and sway braces

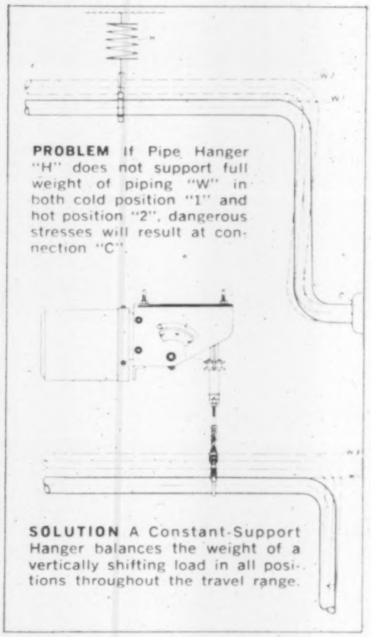


When you have to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing and instant-acting counter force type are recommended. They dampen vibration, oppose pipe sway, absorb shock.

Grinnell Hanger Engineering Service

Grinnell Company's Pipe Hanger Department offers design service to engineers who appreciate the specialized knowledge required. Grinnell will help you compute hanger loads . . . and select proper supports for a *balanced* pipe suspension system.

What's more, Grinnell manufactures a complete line of pipe hangers and supports — and offers stocks of pipe hangers close to any job!

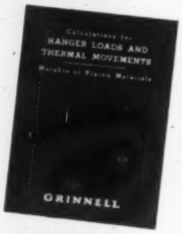


PROBLEM If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".

SOLUTION A Constant-Support Hanger balances the weight of a vertically shifting load in all positions throughout the travel range.

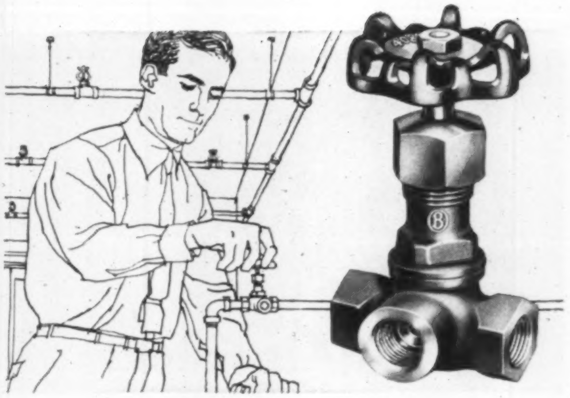
Grinnell maintains an experienced staff of technicians to discover better ways of solving pipe suspension problems, too.

Hanger load calculation booklet


Calculations for
HANGER LOADS AND THERMAL MOVEMENTS
Weights of Piping Materials
GRINNELL

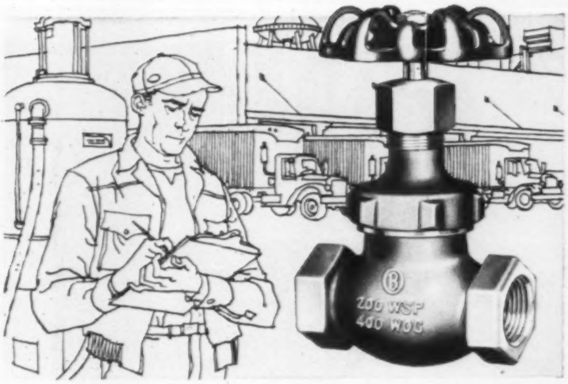
Grinnell will be glad to send you — without obligation — a 32-page booklet, "Calculations for Hanger Loads and Thermal Movements". This helpful booklet furnishes necessary data and procedures to determine pipe hanger loads and thermal movements. Tabulations of piping weights and thermal expansion are arranged for convenient selection of data that usually takes considerable time to develop. Send for your copy *today*. Grinnell Company, Providence 1, R. I. Branch Warehouses in Principal Cities.

O-B Valves have Teflon packing that endures...



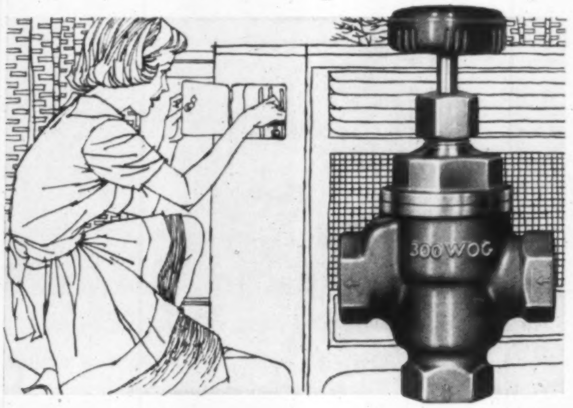
... in sprinkler systems

This O-B No. 408 side-outlet needle valve is ideal for sprinkler systems and in other piping where both "tee" and needle point are needed for effective control. Pressure gauge is often threaded on side outlet. Its tough Teflon-impregnated packing gives long-lasting corrosion resistance.



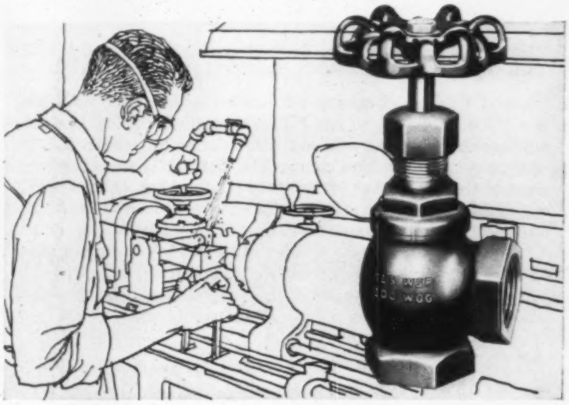
... in gasoline pipelines

Tight shutoff in gasoline and other services makes O-B globe valves (like plug-type No. 1401) most effective—particularly where continual throttling is necessary. The O-B Teflon-impregnated packing safeguards valve operation and helps avert the hazards of corrosion in piping gasoline.



... in room-controlled units

Controlling the output of individual room units in central heating-and-cooling systems calls for this 3-way double-seated by-pass valve. It permits varying output of water to regulate temperature of rooms. Continual on-and-off operation is safeguarded by smooth, flexible, durable Teflon packing.



... in coolant supply lines

Their Teflon packing—impervious to the ravages of oil and other processing fluids—makes O-B globe and angle valves ideally suited for coolant supply. O-B bronze valves such as No. 102 pictured provide tight shutoff of all oil grades. Its semi-plug type brass disc also promotes a tight seal.

10064-Vu

O-B valves—first to use long-wearing Teflon packings throughout the line—offer many feature-advantages in sizes from ⅛" to 3". You profit most when you standardize on the complete O-B bronze valve line. Write for latest catalog information.

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Ohio Brass
O-B VALVES

Ask your distributor for the valve in the orange-and-black box

a new and better way to CLEAN AIR

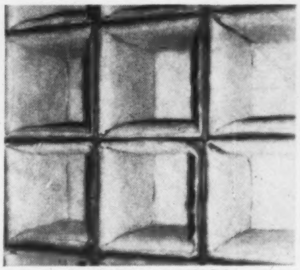
ULOK® Air Filters

Union Carbide research has produced the truly ideal strong, high-capacity filter medium with an irregular, highly-arresting cross section—DYNEL® modacrylic fiber! No other filter medium can touch it for stopping *and holding* unusually large quantities of dust and foreign matter. This dry, un-oiled filter can be vacuum cleaned several times to extend service life even further, if desired.

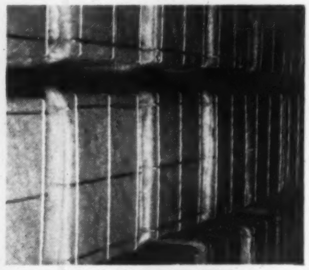
Proved in scores of major installations—in both new and modified systems—ULOK Air Filters are available in a variety of forms to suit any application.

The Remarkable ULOK Cube-Type Air Filter

Shaped like an open-top box with slightly tapered sides, the ULOK Cube-Type Air Filter with *five filtering surfaces* represents the most efficient filter shape yet perfected. In operation, air flow first carries the dirt particles to the back face of the filter. As dirt collects on the back face, and air resistance increases, air flow is shunted to the four sides, assuring uninterrupted filtration. In addition, the ULOK Cube-Type Air Filter provides far greater filtering surface than conventional filters with equivalent face dimensions . . . and the unique design of the wire basket-type retainers and batt edge assures a tight, leak-proof, press fit.

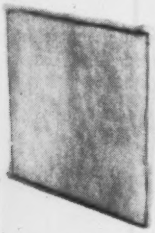


Front (Dirty Air Side)
View of Typical Bank



Rear (Clean Air Side)
View of Typical Bank

Advantages: **• Up to 600% longer service life over other throw-away filters due to higher dust-holding capacity • 22% to 28% National Bureau of Standards atmospheric discoloration efficiency • Easier installation—filter is light in weight; no sharp edges or "splinters" to hurt hands • Lower labor and maintenance costs; lower inventories because fewer changes are required • Easier disposal—simply collapse and discard—leaving dirt *in the bag* • 14 different sizes suitable for all new, and many existing installations • Only $7 to $13 per 1000 CFM of air covers total costs (except labor).**



ULOK Panel-Type Air Filters

Patented method of media formation provides a low-density, three-dimensional batt of high capacity DYNEL modacrylic fiber. Entire face and depth of filter traps dirt particles as inherent strength of medium permits elimination of face supports. Modern ring support provides sure-seal edge and eliminates problem of filter by-pass. Particularly suitable for slide-in applications, and all flat or V-bank installations not adaptable to the Cube-Type Filter. Available in 1″ and 2″ thicknesses, in 9 different sizes, from 10″ x 20″ to 24″ x 24″.

For special applications: ULOK filter media is also available in 2″ Pads, 58″ x 60″. . . in ½″ Rolls, 58″ x 25 yards . . . and in 1″ Rolls, 58″ x 15 yards.

For complete information on ULOK Air Filters, including efficiency and pressure-drop charts, write for new bulletins.

UNION CARBIDE

UNION CARBIDE DEVELOPMENT COMPANY
Division of Union Carbide Corporation
270 Park Avenue, New York 17, N. Y.

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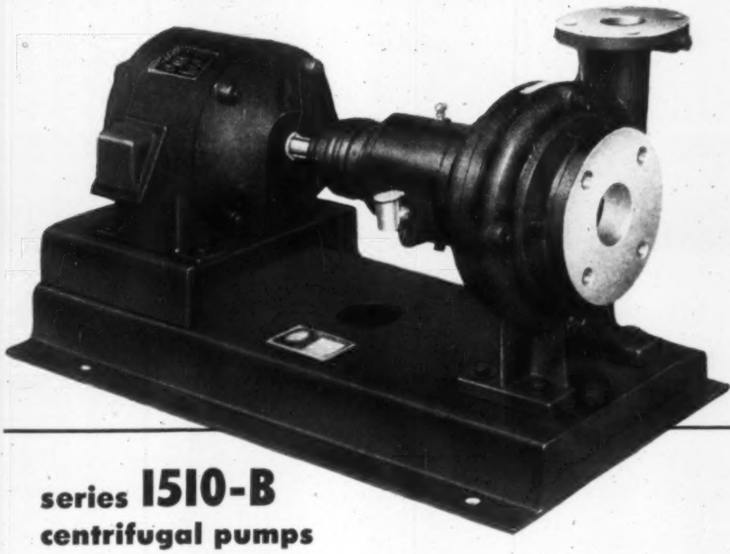


NOW AVAILABLE IN "C" SIZE UNITS UP TO 75 H.P.

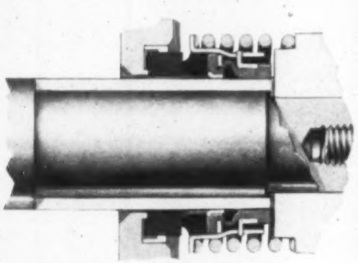
series 1510-B
centrifugal pumps

HIGHER HEADS, GREATER FLOWS AT 1750 RPM!

Now, to its unequalled array of outstanding features, the B&G Series 1510-B Pump adds still another—*a broad range of ratings up to 75 HP*, with capacities to 2000 GPM, heads to 170 ft. and discharge sizes of 3″, 4″, 6″, 8″.

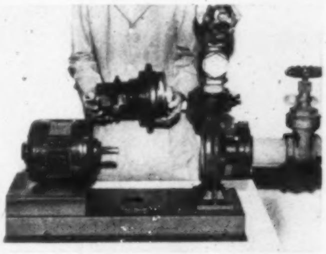
The series 1510-B is a vertical split-case pump designed for smoother, more efficient operation and longer life. Its balanced design enables the bearings to withstand loads far in excess of those developed by any pump and motor combination in the line.

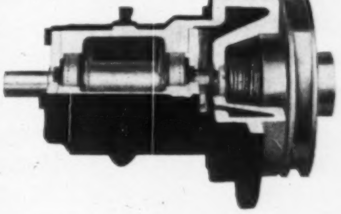
All parts are machined to rigid specifications, carefully inspected and accurately assembled, to insure minimum installation and maintenance expense. Exact uniformity of all parts means easy replacement in the field. All pumps are factory-tested for conditions of head and capacity specified.



LEAKPROOF "REMITE®" SEAL

This exclusive feature assures long, trouble-free life—eliminates the customary leakage which occurs when a packing gland is used. A Carbon Seal Ring faces on a "Remite" floating seat—*a new type of material so hard it will scratch glass—wear-proof and corrosion-resistant.* This Mechanical Seal is self-lubricating. A synthetic rubber bellows seals the shaft. Metal parts are of steel, bronze, or stainless steel, depending upon the type of service.





REMOVABLE BEARING FRAME MAKES SERVICING EASY

The photo shows how easily the complete bearing frame, including the seal and impeller, can be removed without disturbing piping or motor leads. The unit is replaceable and interchangeable in all pump sizes within limits of material construction.

Just five simple steps are required: 1. Loosen coupler set screws. 2. Slide coupler halves back on motor and pump shafts. 3. Remove center drop-out section. 4. Remove volute cover cap screws. 5. Lift out complete bearing frame assembly.

Among the features of the bearing assembly are anti-friction roller bearings to handle thrust and radial loads ... mechanically balanced impeller ... oil lubrication.

STOCK PUMPS FOR QUICK SERVICE

Selected sizes of B&G Series 1510-B Centrifugal Pumps, as well as Series 1522 and 1531, are stocked at the factory for immediate shipment. Capacities to 225 GPM, heads to 140 ft. Send for Price and Selection Catalog.

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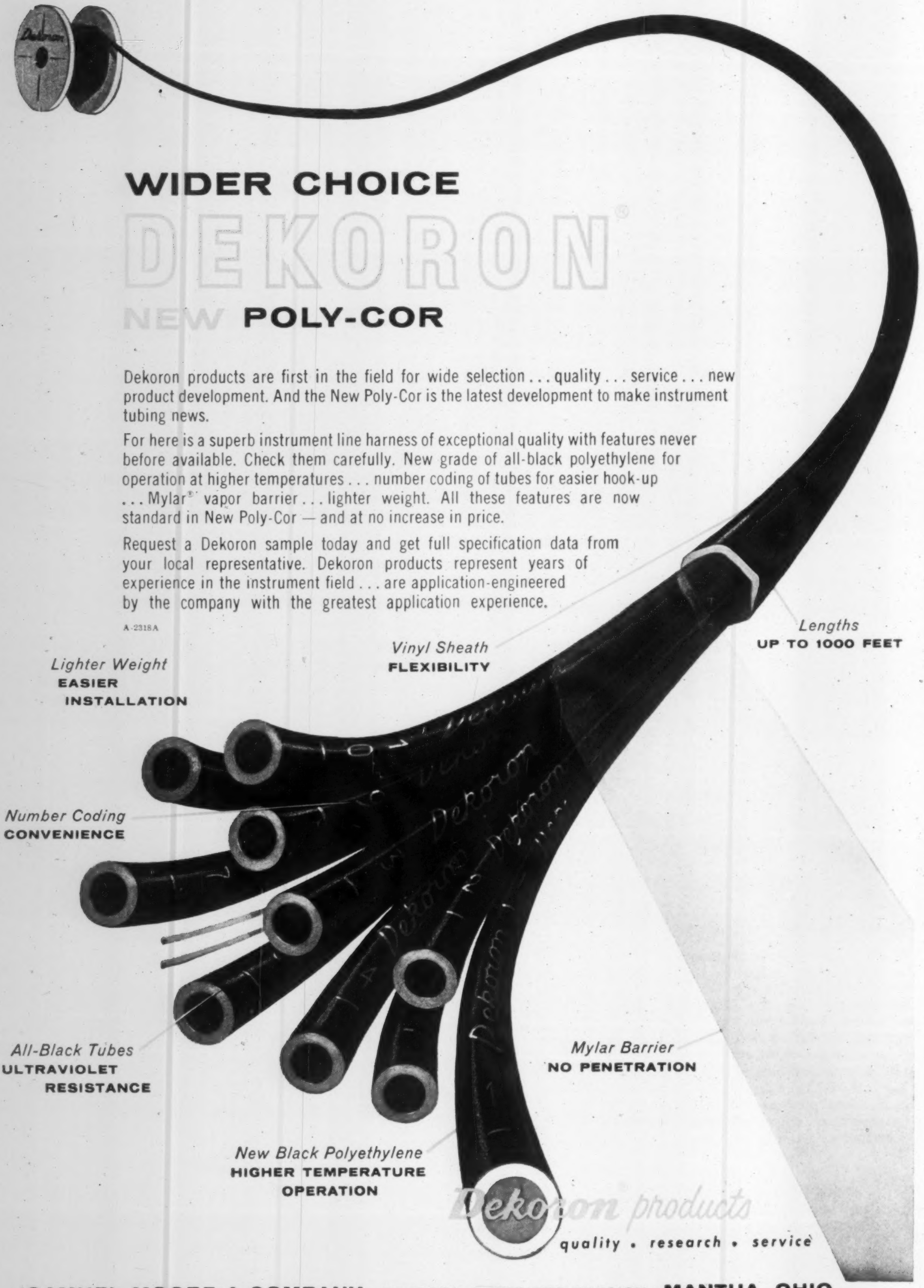
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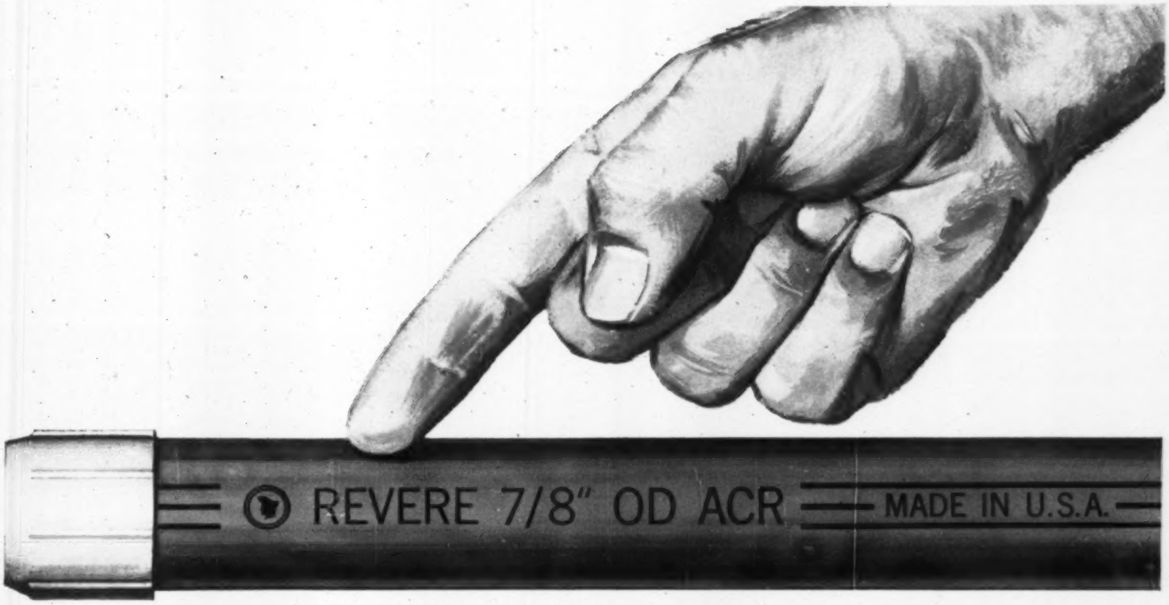

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THE NEW **REVERE ACR** COPPER TUBE

If you haven't, get in touch with the Revere Distributor right away because you're missing a good bet.

Revere ACR Copper Tube comes in hard temper in 20′ straight lengths, in sizes shown in table at right. It is color-coded in blue for fast, sure identification. To make things even more simple, actual O.D. in inches is stamped on each length of tube.

The interior of Revere's Air Conditioning and Refrigeration Copper Tube is meticulously cleaned at the mill and immediately capped on both ends with plastic caps to insure dirt-free, moisture-free delivery on your job site.

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REVERE ACR COPPER TUBE
For Air Conditioning & Refrigeration

Actual O.D. in Inches	Std. Water Tube Size	Wall in Inches	Pounds Per Foot
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.500	⅜	.035	.198
.625	½	.040	.285
.750	⅝	.042	.362
.875	¾	.045	.455
1.125	1	.050	.655
1.375	1¼	.055	.884
1.625	1½	.060	1.14
2.125	2	.070	1.75
2.625	2½	.080	2.48
3.125	3	.090	3.33
3.625	3½	.100	4.29
4.125	4	.110	5.38

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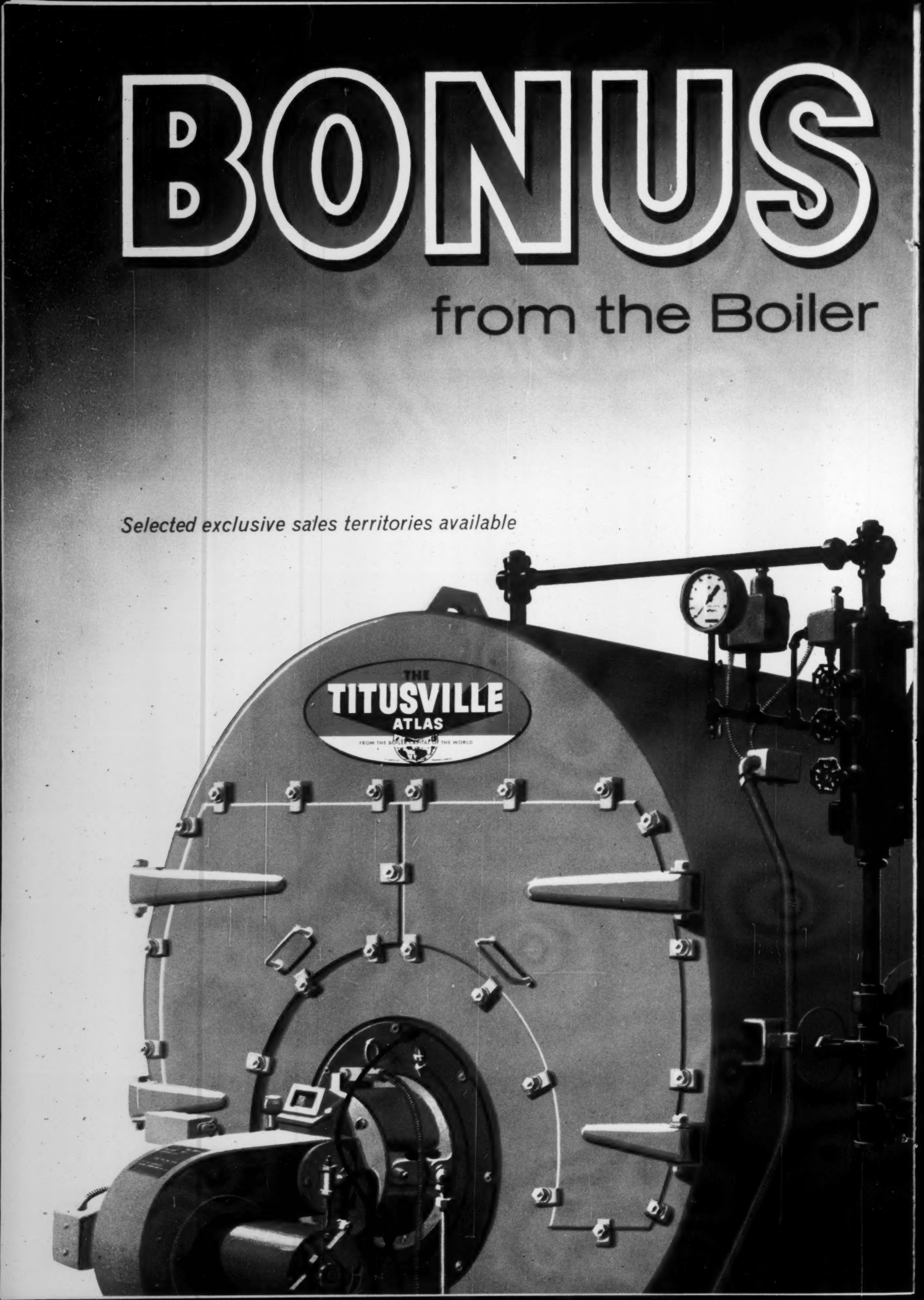
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BONUS POWER means maintained high efficiency . . . longer life . . . less maintenance . . . more horsepower per total energy input. That's what you get when you install a complete TITUSVILLE-ATLAS unit, the only boiler with a patented wet back.

Wet-back design gives you maintained efficiency by eliminating back end refractories. *Result:* no down time for replacement.

Larger furnace area permits reduced fan requirements. *Result:* lower operating costs. Get BONUS POWER. Specify TITUSVILLE-ATLAS.

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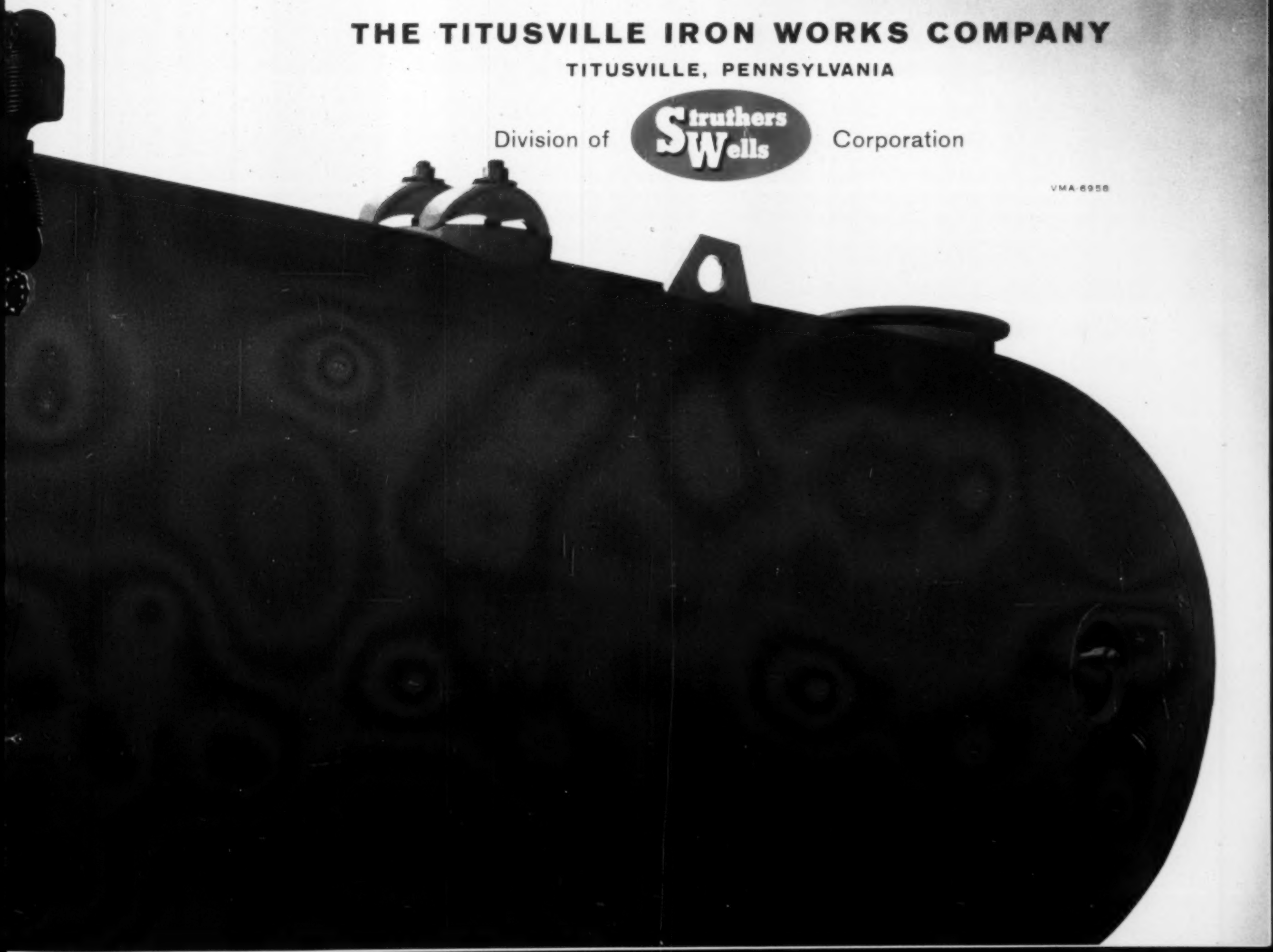

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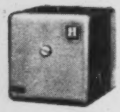
Honeywell's C7012A

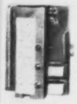
ULTRA-VISION* FLAME DETECTOR

No hot refractory hold-ins!

Satisfy every flame safeguard need with a quality Honeywell control or system



RA890
Protectorelay*



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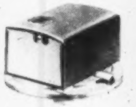

C645
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We follow here each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"Open for Discussion"

Piping Cost Estimates Should Include Bolt Sets, Hangers, Material Handling

I HAVE READ with interest the article, *Good Piping Cost Estimates Demand Basic Understanding of Terms*, by E. John Mark in the January issue.

In estimating a single job great accuracy can be obtained by using procedures such as Mr. Mark has outlined. However, when it is necessary to turn out 10 estimates for every job obtained we find that welding must be lumped together and estimated by a diameter inch basis. We differentiate between shop welds, field welds and cuts, taking these off as we count the fittings. When a fitting is placed next to a piece of pipe the pipe must be cut. However, this operation is eliminated when an elbow is welded to a flange or a "T".

In the Bill of Materials supplied by Mr. Mark there are two important omissions; one is bolt and gasket sets, the other is hangers. We use both of these items extensively to estimate the cost of labor. We have found that hanger installation at least equals the cost of installing the piping, and estimating of bolt sets will automatically account for the labor of handling valves and other flanged items.

Estimate in Hours, Not Dollars

I agree thoroughly that labor be estimated in hours rather than in dollars because the latter has too many variables, both in location of job and in changes in agreement. I further believe that the greatest single contribution toward greater efficiency is in the handling of material rather than in more efficient welding practices or joint make up procedures. Our records show that better than half the labor is expended in getting the material to the point of installation. Therefore a bolt-up on the first floor is far less expensive than one on the 20th, or in the sub-basement.

The logical conclusion, therefore, is that as much work as possible should be done in a shop under controlled conditions.

WILLIAM P. SCOTT, JR.
Scott Co.
Mechanical Contractors

Plaudits for Statement of Hospital Engineering Requirements

THE ARTICLE *The Philosophy of Hospital Engineering* by J. A. Millard in the February issue is on a subject dear to my heart. Mr. Millard is correct in saying that "A hospital is a business" — in fact it ranks third in the country surpassed only by the automotive and aircraft. The author is correct again in saying "Engineering is a Prime Factor" — for truly it is. Engineering is only just beginning to catch up with hospital growth and technology. The $10,000 to $20,000 per bed capital expenditure as stated by Mr. Millard is on the conservative side for quite often $25,000 to $30,000 is the actual case. This is particularly true if nursing education and research facilities are included in the estimate.

Approximately 50 percent of hospital construction contracts are mechanical. There is no prayer, no magic word, or no insurance policy which will provide proper operation and maintenance of a hospital. The only way by which this can be accomplished is through good sound engineering. Engineers of a

Continued on page 100

Ilg Backward Curved airfoil blade design — the *greatest step forward in fan design in 40 years* — eliminates eddy currents and turbulence to assure quieter operation, less drag and shock loss.

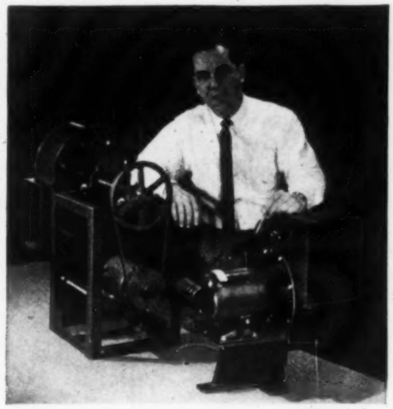
WHEN
IT'S
CENTRIFUGALS,
IT MAKES
SENSE
TO SPECIFY

BE RIGHT . . . WRITE IN

ILG ®

Size Is No Object. Ilg direct-connected BC *airfoil* centrifugals have housings and backward curved wheels of rust-proof aluminum, spark-proof construction with non-overloading characteristics. Streamlined airfoil blade design reduces shock loss. Twelve sizes to choose from for capacities from 1190 to 25,900 c.f.m. For Class I, II, III operations to 9" static pressure. Belted types available in single width, single inlet and double width, double inlet types. WRITE FOR CATALOG DB2-100.

Type of Wheel Is No Object. Both forward curved wheels and backward blade types available on these Type BU and Type FU self-contained, belt-driven Util-A-Sets. Motor mounting on rubber isolation rails checks resonant noise. Twelve sizes to choose from for capacities from 688 to 23,000 cfm. Full line of accessories. WRITE FOR CATALOG DB2-200.



Type of Drive Is No Object. Compact, direct-drive Type B Util-A-Sets . . . and belt-driven Type FU Util-A-Sets . . . meet needs of low-pressure, small-volume supply and exhaust. Type B available in five sizes for capacities from 136 to 1920 cfm. Type FU available in two models for capacities to 2400 cfm. WRITE FOR CATALOG DB2-306.

End Use Is No Object. Type 6S Util-A-Sets (left) and Type P centrifugals (right) are well suited for building into machinery that requires ventilation or air movement. Type 6S direct-connected with 3200 rpm shaded-pole or 5000-10,000 rpm motors. Type P available in four sizes for capacities from 66 to 1160 cfm and pressures to 6½". WRITE FOR CATALOG DB2-302.

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"Open for Discussion"

Continued

caliber equal to those in design have become a must in the field of hospital engineering. Only in the past decade has hospital administration really become aware of this, and begun to do something about it.

Need Is Now Recognized

Administration each day is competing more and more for the graduate and registered engineer because they have come to realize that protection of this multi-million dollar investment lies in good engineering practice. Administration knows too, that the bailing wire and pliers mechanic or the fix-it man is not enough to keep abreast of the modern hospital. Training of and by the hospital engineer is a problem of prime importance. When this problem is properly met by all responsible people in the hospital field, a great number of headaches will be only memories.

My compliments to Mr. Millard for his courage in telling "The Philosophy of Hospital Engineering" in his article.

RICHARD T. DANKS
Supervising Engineer
Hospital Sisters of the Third
Order of St. Francis

Asks Clarification of Conductance Effect From Finned Streamlined Tubes

I WOULD LIKE to compliment David M. Adams on his very interesting article, *How Finned Streamlined Heat Exchanger Tubes Perform* in the February issue. There were one or two points which were not too clear, and I would appreciate it if Mr. Adams could clarify them for me.

Since the circumferences of the circular and the streamlined tubes tested were equal, the cross-sectional area internal flow must vary. What allowances were made for this variation in the evaluation of overall conductance, and particularly in the evaluation of the air side conductance?

Compensation for Shape Differences

If we assume equal mass velocities within the tube, was any effort made to modify the water side conductance because of the differences in shape of the tubes?

If no allowances were made for the conditions indicated in the first two questions, what was the representative order of the inside and outside conductance? Specifically, was the inside conductance high enough so that omitting this modification would not appreciably affect the conclusions?

ALAN S. DECKER
Vice President, Engineering
Dunham-Bush, Inc.

THE AUTHOR'S REPLY — Since the cross-sectional areas of the streamlined and circular tube were different, the conductance through the former cross-section was calculated to be approximately twice that through the latter cross-section, for equal water mass rates. A small water flow rate was used (21 lb_m/min) through the single tubes so as to obtain accurate water temperature measurements. Thus, the internal conductances were not negligible in either case. This can be noticed from Fig. 4 in the article where the air side conductances reveal the differences. Therefore, the overall conductances of the finned streamlined tube over those of the finned circular tube were partly due to the differences in the internal conductances.

To modify the results for negligible internal conductances, the equation for the ratio of the air side conductances for the finned tubes was calculated as

$$(hA)_{fs}/(hA)_{fc} = 0.4345(N_{Re})^{0.168}$$

For the range of air flows used, the air side conductances for the finned streamlined tube ranged from 44 to 89 percent greater than those for the finned circular tube. The results would be changed somewhat if the internal conductances in both cases are negligible, but it must be noticed from Fig. 4 that the fin effectiveness for the finned streamlined tube increases, whereas it decreased slightly when based on the overall conductance.

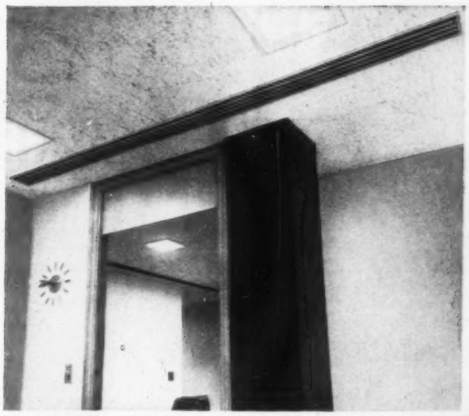
Using equal water mass rates for the comparison enabled the analysis to be made for internal conductances that are *not* negligible and for internal conductances that *are* negligible. Also, the analysis of the water pumping requirements does not enter as a parameter (neglecting the relative pressure losses through the tubes which are minor).

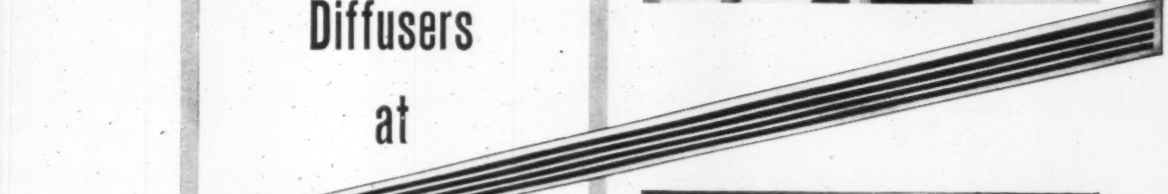
For equal water mass flows, the overall conductance will approach the air side conductance as the water flow is increased, and the results will range between the two given above (negligible and non-negligible internal conductances). The overall resistance (reciprocal of conductance) will decrease along with the water resistance, causing the air side conductance to remain approximately constant (it will vary somewhat due to water and air property changes as a result of surface temperature changes) for a given air flow.

In conclusion, when the internal conductances are not negligible, the shape of the cross-section of the streamlined tube is advantageous. At negligible conductances, when this advantage is not realized, the

Continued on page 104

New Anemostat Architectural Straight Line Diffusers at Cornell University





Here is the new Anemostat ASL Architectural Straight Line Air Diffuser installed in the Willard Straight Hall of Cornell University at Ithaca, New York. This new ASL unit for ceiling or wall application combines the superior air diffusion characteristics of all Anemostat air diffusers with the esthetic appearance of a slender unit with symmetrical vanes. The ASL diffusers are easy to install; no screws, nuts or bolts are needed.

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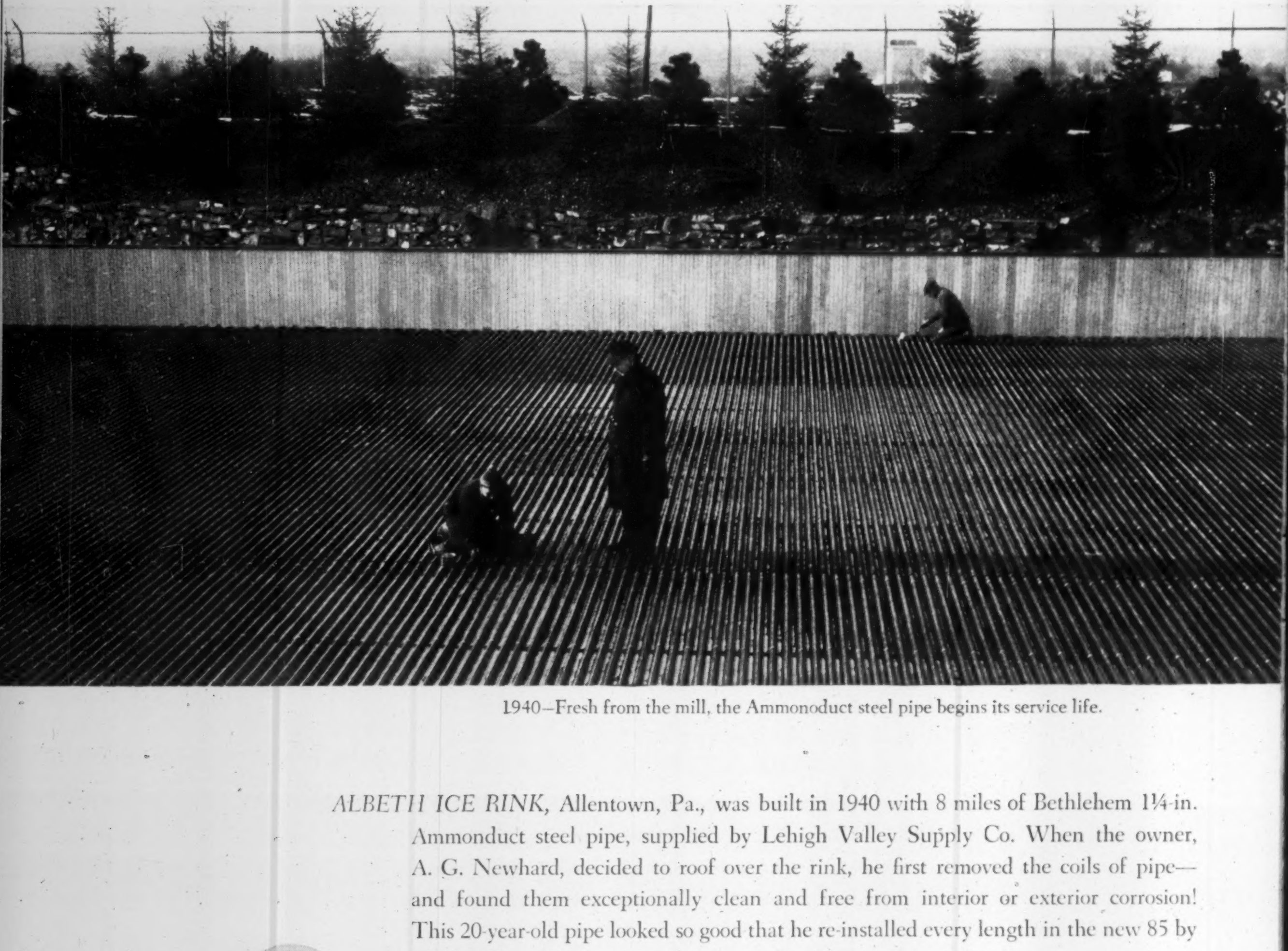
AC1-79

Steel pipe outlasts 20-year rink ...and begins service in another!



1940—Fresh from the mill, the Ammonoduct steel pipe begins its service life.

ALBETH ICE RINK, Allentown, Pa., was built in 1940 with 8 miles of Bethlehem 1¼-in. Ammonduct steel pipe, supplied by Lehigh Valley Supply Co. When the owner, A. G. Newhard, decided to roof over the rink, he first removed the coils of pipe—and found them exceptionally clean and free from interior or exterior corrosion! This 20-year-old pipe looked so good that he re-installed every length in the new 85 by 185-ft rink now operating on the same location.

When you need dependable refrigeration pipe, specify *steel* pipe—and get economy as a bonus. Any Bethlehem sales office will be glad to give you more information.

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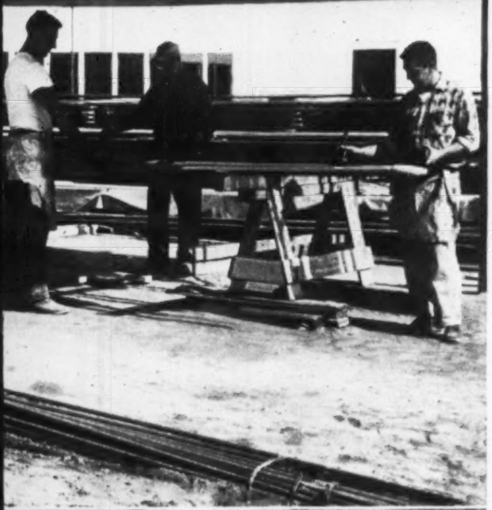

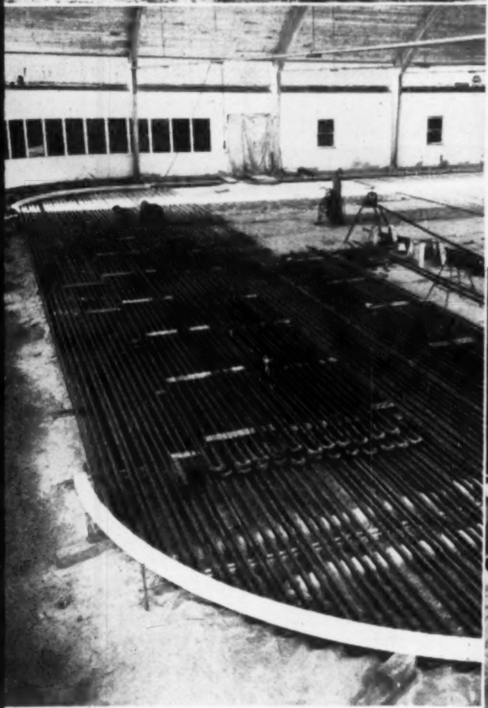

After serving 20 years in one ice rink,
the Ammonoduct steel pipe
was taken up during remodeling,
brushed clean and recoated . . .
and then every length was re-installed
in a new rink on the same location.

1960–Re-installed in the new rink, the steel pipe continues to perform perfectly.

Steel pipe is first choice for ice rinks

- costs less than any other ferrous piping material
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INSIST ON STEEL PIPE MADE IN U.S.A.

"Open for Discussion"

Continued

results will be altered as shown earlier. However, in this case, the fin effectiveness of the finned streamlined tube will increase instead of decrease.

If the comparison were based on equal water conductances (smaller water mass flow through the streamlined cross-section), the overall conductances for the finned circular tube would be higher relative to the finned streamlined tube and the results given in the article (51 to 89 percent greater overall conductances) would be lowered by approximately ten percent. However, the water pumping requirements for the streamlined cross-section would be substantially reduced; more than enough to offset the above reduction. Also, the comparison based on equal water mass rates is more favorable in the practical sense. The above reductions would not be realized when the internal conductances are negligible (that is, the same results on the previous page will apply), and at this point, the water pumping requirements would still be reduced.

The analysis of the effectiveness of finned streamlined heat exchanger tubes is quite detailed. Much work has yet to be done on them.

David M. Adams

Notes Effects of "Multiple Banking" On Finned Streamlined Tube Data

With reference to the "HPAC Report on Research" in the February issue entitled, *How Finned Streamlined Heat Exchanger Tubes Perform*, by David M. Adams, I would like to offer the following comments:

1) Other published data as well as our own test experience indicates that streamlined tubes when arranged in fin-tube bundles or banks do not produce the higher heat transfer coefficients and lower pressure losses at comparable Reynolds numbers.

2) Results based on a bank of tubes two or more rows deep in the direction of flow would be more valuable.

T. W. Ernst
Manager
Coil Sales Dept.
The Trane Co.

The author's reply—I have, in my thesis, made reference to results obtained by Alco Products, Inc., of Beaumont, Texas. Their results for multiple banked tubes confirm Mr. Ernst's comments. However, their fin-tube geometry was quite different from that presented in the article. Thus, the consideration of fin-tube (or bare tube) geometry is most important when attempting to compare results. Pertaining to a single bank, the primary variable that would influence the results presented would be the fin-tube spacing, but this spacing would influence both types of geometry.

It was desirable to test a bank of tubes or even multiple banks, but the financial problem limited the tests to single tubes.

David M. Adams

Comments on Design, Heating of Campus-Type Schools — Continued

Mr. Tower's rebuttal, in the February issue, to my comments on the "Plateau Method" campus type school are interesting but somewhat puzzling. I will take him at his word that no "fast talking" architect was involved in this case. Who, then, "sold" this expensive design? Someone had to — such expensive projects don't sell themselves. Was it the school superintendent? This has happened many times, of course, as was pointed out in the Reader's Digest article,* also. However, the following items would seem to be very pertinent in evaluating the problem:

1) We are told that the school board concluded, after long study, that the campus type school best fitted their needs. What needs? Other than the alleged (and unsupported) advantage of age segregation, none are listed. In these comments I have noted as I did before some reasons of proven magnitude for going in the opposite direction.

2) In presenting the case to the public, to what extent did the superintendent and school board (together with the architect) make known the considerable increase in cost, and the many obvious disadvantages of the campus type school? It would be interesting to read the article which the superintendent wrote to support his viewpoint.

This example, recently told to me, illustrates the tragedy of such ill considered, expensive projects. It is probably an extreme case, but this does not in any way nullify the point: The school board of a midwestern town of modest size developed a needed high school project. The original architectural estimates were in the vicinity of a million dollars. Then, at the urging of the superintendent and an architect, they too visited a number of schools and came back with "campus fever." The final installation for the same capacity cost in the vicinity of three million dollars. Today, a few years afterward, the district is out of bonding power and much needed expansion cannot be made, the school is on part time sessions, needed equipment cannot be purchased and adequate teach-

---

**How to Have More School for Less Money*, by Charles Stevenson, Reader's Digest, February, 1959

Continued on page 108

MR. ENGINEER:
LET'S FACE THE FACTS . . .

Can you be sure your underground piping system is watertight if you can't *AIR TEST* it?

Test caps applied to unit ends for air testing full-welded conduit system.

During air test, conduit field welds are checked with soap solution.

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New general offices of Swanson Brothers in Omaha, Nebraska. Air-conditioned efficiently and economically by gas-operated Carrier absorption refrigeration. Architects and Engineers: Leo A. Daly Company. Mechanical Contractor: J. J. Hanighen Company. Both of Omaha, Nebraska.

SWANSON BUILD
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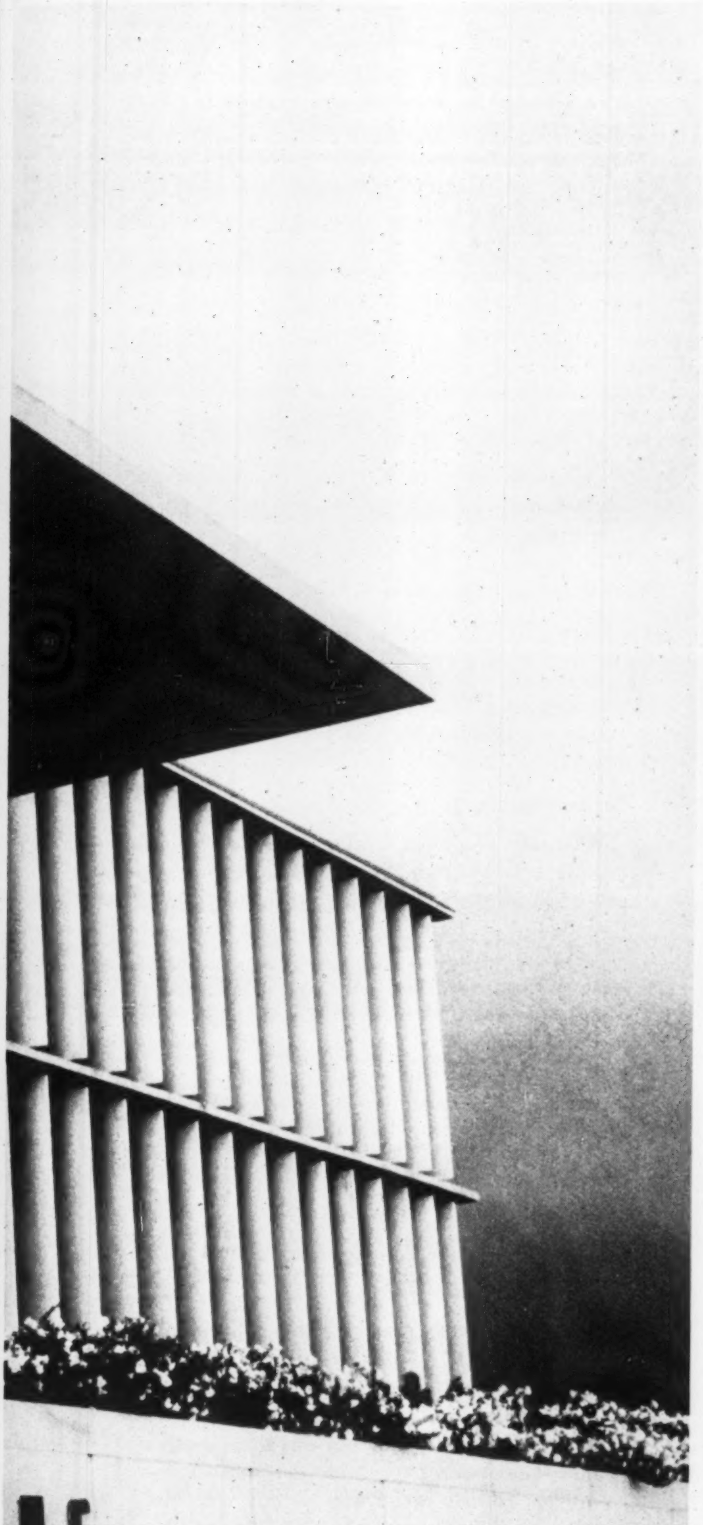


Swanson insures low operating costs with GAS and CARRIER absorption refrigeration

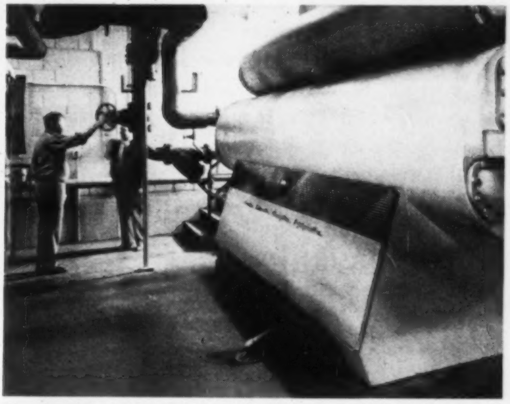
Swanson Brothers – nationally known in the foods industry – chose gas-operated Carrier absorption refrigeration to air-condition their beautiful new general office building in Omaha, Nebraska.

The basis for their choice was *lower operating costs*, with the unbeatable fuel economy of gas and the simplicity and trouble-free operation of the Carrier absorption unit. With no major moving parts, it quietly and efficiently uses steam from a gas-fired boiler to provide chilled water for cooling.

Carrier has solved the problem of sustained efficiency at partial loads in absorption cooling. An exclusive Carrier solution-capacity-control gives partial load efficiency unsurpassed by any other type of cooling system.

You can keep air conditioning costs low and efficiency high, with gas-operated Carrier absorption refrigeration. For details call your local Gas Company, or write Carrier Air Conditioning Company, Syracuse 1, New York. *American Gas Association*

FOR HEATING & COOLING
GAS IS GOOD BUSINESS!



Trouble-free is the word for this 140-ton capacity gas-operated Carrier absorption unit at Swanson building. Says Wendell Mitchell, Building Engineer, "I really think this system is great. All I have to do is check it now and then. Never a bit of trouble."

"Open for Discussion"

Continued

ing salaries are not available. We have similar elaborate schools in my area. Some of these districts are definitely in vote and bond trouble.

Is this what our "modern" architects and educators mean by "raising the cultural sights of the community with school buildings that express an aesthetic ideal?" With our local, state, and national debt totalling around $500 billion and the present pressure of the national administration to spend more billions on school construction, it should be obvious that we cannot afford such luxuries. Educators, school boards, architects, and mechanical engineers all have a heavy moral responsibility to see that the public's limited educational funds are spent wisely and economically. They should keep in mind that they are not only obligating today's taxpayer, but future taxpayers as well, for another 20 years — the usual bond life. Economical construction does not infer nor require poor quality or ugly buildings. The schools are provided for education — true education. A country club atmosphere is not needed, does real harm by creating a false sense of values in our young people, and simply cannot be afforded by our economy.

Architects and engineers are paid to serve the best overall interests of their clients — in these cases, the taxpayers. Professionally they should take positive steps to oppose such designs. Instead, encouragement is provided by "school of the year" and similar awards. After factual experience, how many hard pressed taxpayers would second such dubious honors? A friend of mine has pointed out that the great majority of architects and engineers do stick to fundamental, proven, economical designs. But these have no publicity value. The public hears little about such well built schools.

Our "modern" architects refer to what they derisively call the "box" type of design with obvious distaste. But it has evolved logically, and it has proven advantages. It has stood the test of time. How about the aesthetic aspects of this design? I am told that a famous teacher of architecture once made this point: Any architect with unlimited scope and funds should be able to turn out a beautiful well designed building. A truly great architect can do this with limited scope and funds. Doesn't this answer the question? Communities should seek out these architects and engineers.

Now let's review the disadvantages of the campus type school and what the mechanical engineer should do about the problem:

1) Multiple buildings of the same type and floor area are always more expensive to construct than a single-unit.

2) The heating loads of such designs are high because of the additional exposed wall areas, the long runs of the heating lines (particularly underground) and the huge infiltration loads caused by the students and teachers entering and leaving the buildings frequently. This is reflected in the large boilers installed for the Bethel school (Please note: My original comments said *installed, not required.* Obviously there is a relationship, however.)

3) The duplication and long runs of the utilities, particularly underground, add considerably to the expense.

4) With such wide spread buildings needless time is wasted going from building to building. The teachers, as well as the students, are handicapped by this requirement.

5) During inclement weather the students and teachers must go outside to reach the gym, swimming pool, auditorium, cafeteria, library and classrooms. This requires outer apparel, and a place to hang this apparel in each building. It is not wise for students who are wet or sweaty from swimming or gym to go outside in cold weather.

Group Action Is Required

What can the mechanical engineer do to make these facts known to the public? He cannot do it directly because the architect is his client and he might soon be out of business. Ethics would also be involved. But such facts can be publicized through group action in ASME, AIEE, ASHRAE, and the other professional engineering societies. We have a moral obligation to do so. Mechanical engineers — wherever you are — speak up! Be heard!

John H. Clarke
Engineering Design Supervisor
Air Conditioning and Power
The Visking Company
Div. of Union Carbide Corp.

In the article, *Good Procedures Forestall Corrosion In Hot Water Heating Systems,* by R. H. Hayman in the March issue, Figs. 4 and 5 were transposed. Fig. 5 (as presented) shows a system which is liable to corrosion because pump discharge pressure is not sufficient to provide positive pressure at the air vent, and allows air to enter the system. Fig. 4 in the article shows the same system with direction of flow reversed to maintain positive pressure at the air vent.

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a sensitive instrument that will give instant direct reading of air flow in feet per minute. Readings as low as 20 f.p.m. can be made. The triple graduated scale on the dial can register a high of up to 24,000 f.p.m. or 20 in. of water.

The Velometer will give direct reading of static pressure in ducts, plenum chambers, or pipes. Register pressure loss across heater and filters, friction loss at ells and deflectors. Many government and municipal jobs require Velometer checking before acceptance.

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Registers surface temperatures accurately and instantly by simply touching the thermocouple tip to any surface, or will register air temperatures at grills, inside ducts etc. with the air temperature thermocouple tip. Saves time with quick, positive readings. Can be used to set thermal expansion valve on cooling coils in less than a minute.

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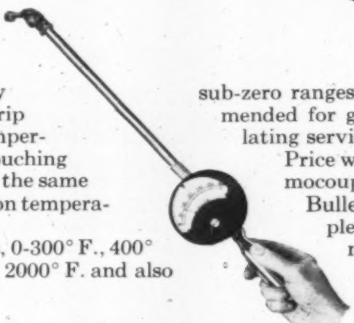

A compact hand held pyrometer with heavy-duty shock-resistant construction and with a firm grip handle balanced for easy handling. Accurate temperature readings are registered immediately on touching the tip to any surface. Can be used for practically the same service as the Alnor Pyrometer described above on temperatures within the range of the instrument.

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question of the month

"Can No. 6 Fuel Oil Be Used for Heating Large Installation Where Constant Modulation Is Required?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with two answers that have been received from readers. Additional answers were presented in the March and April issues. Other solutions or comments for publication are invited.

"I am preparing a design for a new heating system for our plant, and will use unit heaters and convectors with hot water at a pressure of 50 psi and temperature of 300 F.

"The estimated capacity required will be 10 million Btu per hr. It is proposed to use two oil fired boilers of equal size, with a combined output of 12 million Btu per hr. The fuel being considered is a No. 6 fuel oil, with a viscosity of 3500 Saybolt seconds.

"The burners will have to be modulated constantly to satisfy the variable heating load, and I am wondering if it is wise to consider such a heavy oil for this purpose. I realize that No. 6 fuel oil will require preheating prior to combustion, but the operating cost with No. 6 oil will be considerably lower than with lighter fuels.

"I would like to hear from other readers of Heating, Piping & Air Conditioning about this and learn what their experiences have been with No. 6 fuel oil for large installations of this type." — R.A.W.

Furnace Design Details Will Be Of Prime Importance to Efficiency

IN REPLY to R.A.W.'s question concerning the burning of No. 6 fuel oil, this can be done very satisfactorily with many types of burners if the proper conditions are created.

He establishes the specifications for his No. 6 oil and it must be assumed that the quality will be reasonably uniform.

He states that his maximum load is 10,000,000 Btu per hr using two boilers with a combined output of 12,000,000 Btu per hr. Rotary cup burners may be used equipped with integral dual pump and reservoir and viscosity control. Each burner would have a 4 to 1 turndown so if both boilers were operated in sequence, his total turndown would be 8 to 1. This should be adequate for the heating installation in question.

The burners would be adjusted to fire between 25 and 50 psig from low to high fire. The oil temperature should be maintained at 120 to 140 F and proper provision made to heat the oil in the storage tank adjacent to the suction line, to eliminate excessive load on his transfer pump.

No mention has been made by previous commentators concerning furnace design. It is my opinion that this is most important. The radiant heat from an incandescent refractory acts as a catalyst to accelerate combustion. A properly designed furnace built to the burner manufacturer's recommendations with particular attention paid to the dimension from the center line of the burner to the furnace floor is imperative. The secondary air should be introduced through a windbox with adjustable air louvers top and bottom to maintain a constant relative windbox pressure. The furnace front should be the refractory ring type to admit air concentric to the burner nozzle. The primary air, secondary air and fuel should be automatically controlled by interconnected linkage in response to the load demand. The entire furnace including the ring type front should be sized according to the flame characteristics of the burner to avoid flame impingement. This should provide an efficient

Continued on page 112

This mark tells you a product
is made of modern, dependable Steel.

"We've been buying from National Tube Distributors for almost 25 years—and they've never let us down."

So says Mr. Stanley Carter, President, Stanley-Carter Company, Mechanical Contractors, Detroit, Michigan. *"Good distributor service is tremendously important to our profit margin. That's why we've been working with National Tube Distributors as long as we have.*

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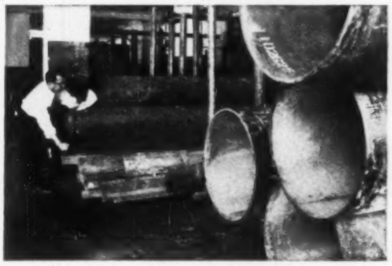
"We kept a big job right on schedule in Nashville, Tennessee, when the USS National Pipe arrived exactly at the time they promised it.

"It looked like we were headed for trouble on a big Detroit job this year. We needed a lot of pipe in a hurry. All it took was a few phone calls. We received the pipe within 24 hours."

"National Tube salesmen and distributors back us with technical assistance. They not only keep us abreast of changes in specifications but offer recommendations if specifications need to be changed."

"On this job, the distributor worked with the architect when a spec change was needed—the new specification was just as good for this particular job, and it saved us serious delays.

"A National Tube salesman helped recommend a specification equal to the original spec but for a less expensive material on a plant expansion job we were doing. Cut the cost about 10%."



"Another thing we like. These National Tube Distributors carry a complete stock of pipe sizes.

"And the quality is excellent. In the past 20 years, we've had no trouble with USS National Pipe. If trouble were encountered, we know help is as close as our telephone. We can call our National Pipe Distributor or National Tube, and the team goes into action immediately."

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trouble free installation.

It is assumed that all burner installations receive normal maintenance and that would be required of this one.

FRANCIS G. BASTICK
Vice President
Automatic Burner Corp.
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First Cost Will Be Greater, But Overall Saving Is Possible

THE PRACTICE of using No. 6 fuel oil in a burner designed for modulating service can be treated much the same as with lighter oils. While provision must be made for adequate heating and maintaining temperature of the No. 6 oil, the problems are not appreciably different from other fuels. The fuel pump will deliver a constant volume and the fuel not burned will be recirculated. The first cost and maintenance of controls and safety devices for No. 6 oil is greater, but the saving in fuel costs will more than offset this for a substantial annual saving.

LESTER MAURER
Mechanical Engineer
Giffels & Rossetti, Inc.
Architects & Engineers

"Will Substantial Air Supply Above Hung Ceiling Prevent Condensation on Cool Air Ducts?"

"How can we dispense with anti-condensation insulation covering on cool air ducts when the ducts are to be hung above an acoustical tile ceiling?

"This problem has arisen in the design of an air conditioning system for an industrial plant of 50,000 sq ft area, one story construction, with a height of 24 ft to the roof. Other construction features include standard brick wall, sash and aluminum siding for walls, insulated metal decks, and built-up roofing.

"The system design is based on maintaining conditions of 75 F DB and 62 F WB inside when outside temperatures are 95 F DB and 75 F WB. Four roof-suspended air handling units will mix 20 percent outside air with 80 percent return air. The units have integral chilled water cooling coils, and will discharge air at 59.6 F DB and 53.5 F dew point, through main ducts to diffusers.

"The system was originally designed for an "unceilinged" area. With air handling units and distribution ducts installed, an 18 ft ceiling was added, leaving a 6 ft space above.

"If we isolate the ceiling space from the work area below by providing each with its own supply and return air system to and from the air handling units, can we, by controlling the mixture above the ceiling, prevent condensation on the ducts? About 85 percent of the air quantity would be distributed below the ceiling with this plan. This would effect one outside air ventilation change per hr. The remainder of the air would be distributed above the ceiling.

"Answers and comments from other readers on this proposition would be greatly appreciated."— J. M.

Cites Ways to Prevent Condensation, Notes Insulation Is Best Insurance

WE ARE GLAD to give our opinion regarding the question of preventing condensation on air conditioning ducts above a suspended ceiling.

It is the practice of our office to specify insulation of concealed air conditioning supply ducts because we have found through experience that even if condensation will not theoretically exist, there are frequently practical considerations on the job that change conditions and cause condensation to form.

In the example mentioned, the inside conditions are stated to be 75 F DB and 62 F WB which correspond to a dewpoint of 54 F. If we can assume that a supply air temperature of 59.6 F DB and a room dewpoint of 53.5 to 59 F will be maintained due to a relatively constant load, condensation will not form on supply ducts exposed in the air conditioned space. If under the same conditions the supply ducts are placed above a suspended ceiling, we would not expect condensation to form, providing supply air is introduced to the space above the ceiling as mentioned in your letter. However, the air should be supplied uniformly so as to cause as much air motion as possible around the ducts. In order to provide more air motion and for other reasons, we would prefer to place return grilles in the suspended ceiling and draw all return air through the upper space back to the units. In this case we would eliminate the supply air openings to the upper space together with whatever control devices are anticipated.

It is our opinion that either of the two above methods will prevent condensation on the ductwork in this particular installation. Using the suspended ceiling space as a return air plenum is undoubtedly the surer method, but it has objections such as a) the possibility of conflict with fire prevention laws, b) the accumulation of dust in suspended ceiling space, c) the rise of supply air temperature on long runs, and d) the possibility of outdoor air leakage causing trouble.

On account of all of the above and also because load conditions might change in the future, we believe the wise thing to do is to insulate the ducts.

W. CLARENCE HABERER
E. R. Ronald & Associates
Consulting Engineers

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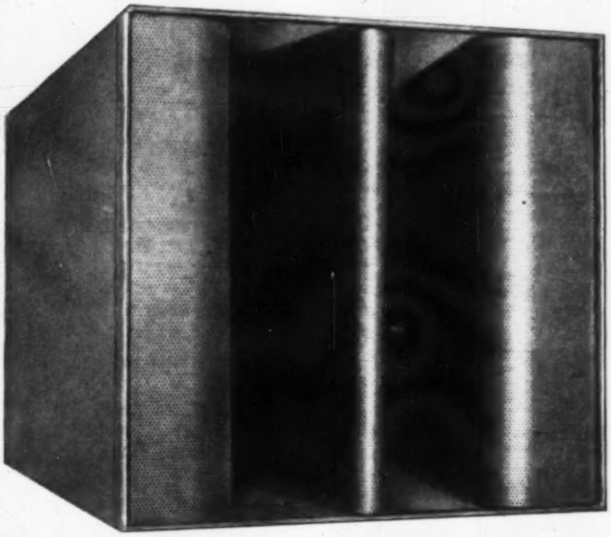

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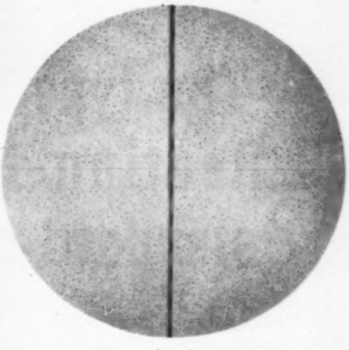

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NASH ENGINEERING COMPANY
449 WILSON, SO. NORWALK, CONN.

A CHICAGO public housing project, where 15 high-rise apartment buildings are heated by floor and ceiling radiant panels supplied from a central boiler plant via individual building converters. Project occupies 15 city blocks, provides almost 2000 dwelling units

A 15 building apartment project —

Radiant Heating Permits 90 F Temperature Drop, Allows Use of Low-Temperature, Low-Pressure Boilers

BEFORE SELECTING a radiant heating system as the means to heat the large Frances Cabrini Homes project in Chicago, an extensive study of the requirements was made by William Goodman, consulting mechanical engineer. One of the first considerations was the need for low operating and maintenance costs, since Cabrini Homes is a public housing project.

The achievement of the low-cost objective is attested to by Clifford E. Koyen, chief operating engineer for the project, who notes that in 25 years of engineering experience he has never operated a heating system with such ease, lack of operating problems, and small amount of maintenance effort.

Consider Temperature Drop Factor

Since these buildings were to be supplied with circulating hot water from a central boiler plant, one installation economy was apparent. By designing the plant for a large temperature drop in the circulating water, a consequent reduction in underground pipe sizes and pumping capacity could be obtained. However, to do this a conventional 200 F hot water system would require a high pressure boiler plant capable of supplying water at about 325 F — assuming a temperature drop of 100 F.

Radiant System Is Answer

By installing a radiant heating system, requiring water at a maximum temperature of 130 F, a low pressure plant which would supply water at a maximum temperature of only 220 F could be used. As finally designed, the system makes use of a 90 F temperature drop through the extensive underground piping system.

Normally, the temperature of the circulating water as it leaves the boiler house is well under 220 F. An indoor-outdoor control varies the water temperature at this point, according to weather conditions and the demand from the buildings. Because the circulating temperature is relatively low, underground losses are small.

During the summer, the central boiler plant is completely shut down. It would have been uneconom-

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. . . as told to HPAC
by William Goodman
Consulting Mechanical Engineer
Chicago, Ill.

ical to operate the large boilers for the sole purpose of supplying the comparatively small domestic hot water load. In fact it's quite possible that the heat losses in the piping would have been greater than the water heating load itself, and to tolerate such an operation would be analogous to letting the tail wag the dog.

Instead, domestic water is heated by means of fully automatic gas hot water heaters in each building, and overall a greater economy is achieved.

How System Is Designed

The Cabrini project consists of 15 apartment buildings and was constructed in two stages: the first, with one 19-story, two 10-story, and five 7-story buildings, with a total of 859 apartments in the eight structures; and the second stage with two 19-story, three 10-story, and two 7-story buildings, which together provide some 1062 dwelling units. The entire project occupies an area of 15 city blocks, and was completed in 1955-56.

Each of the low pressure Scotch marine boilers is rated at 350 boiler hp, but may be fired slightly over 150 percent of rating to develop about 550 hp. The total boiler capacity at this firing rate is slightly in excess of 3300 boiler hp. Rotary-type burners are used, with No. 6 fuel oil.

Each boiler has its own fuel oil system, burner, pump, fuel oil heater, 30,000 gal storage tank, stack, and connecting piping, and each is equipped with a separate induced draft fan and relatively short steel chimney.

The number of boilers operating at any one time depends, of course, on the heating load. The six units follow either an operating start sequence of Nos. 1 through 6, or an exactly reversed pattern, but further variation in this sequence can be achieved simply by opening the main disconnect switches on any of the boilers.

Maintain Continuous Pumping

Another important feature of the design is the provision for the continuous operation of at least one circulating pump. This means that even when no boiler is on the line, one pump continues to operate, insuring good circulation through the underground distribution system. The circulating pumps are double-suction, horizontal split-case, bronze fitted with bronze impellers and bronze wearing rings on impeller and casing. Each has a capacity of 450 gpm against a head of 115 ft. The suction side of each pump connects to the outlet of one boiler.

Use Common Expansion Tank

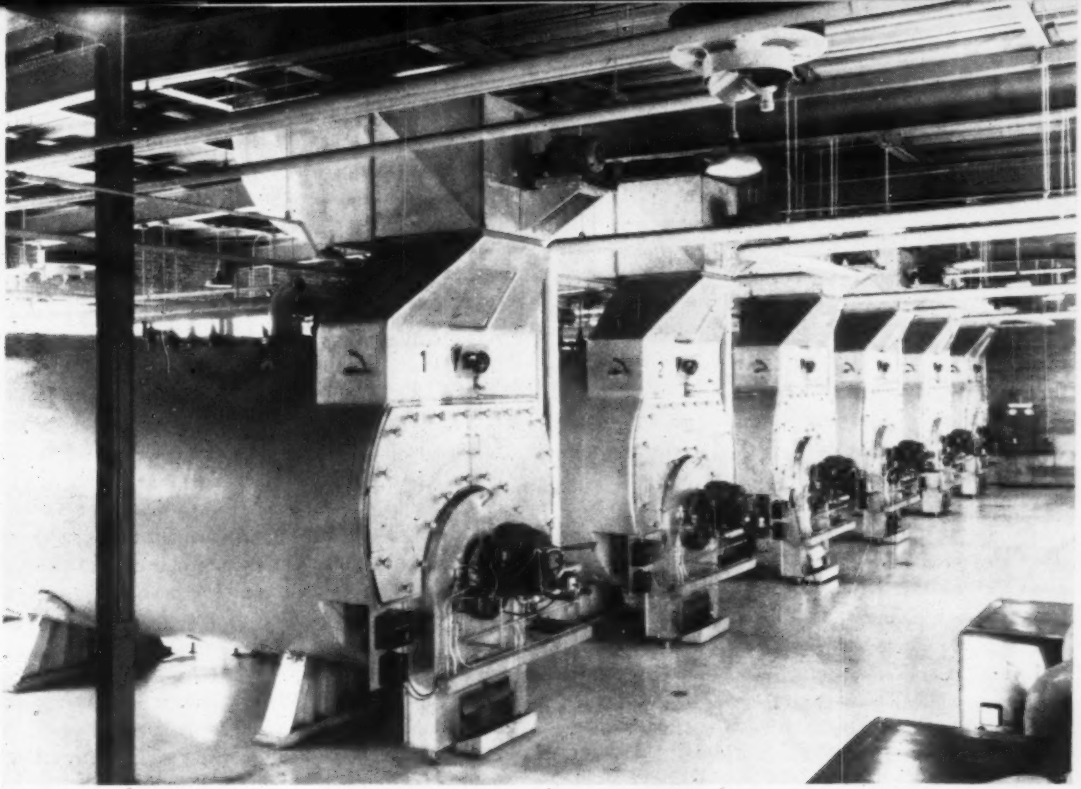
The expansion tank for the distribution piping system is connected to the return header, which in turn is linked to all boilers. Compressed air is used to maintain a closely controlled pressure on the boilers below the relief valve setting.

Buildings Have Own Converters

Hot water is delivered to counter-flow shell and tube converters in each of the 15 buildings. The converters are designed for a working pressure of 175 psi on the tube side, and 125 psi shell-side. Every structure has its own expansion tank, plus hot water circulating pumps of the non-loading, single suction, vertical split-case type, with mechanical seals and bronze impellers.

Water for the radiant systems is heated in the converters to a temperature of from 100 to 130 F in minus 10 F weather. An indoor-outdoor control in

CIRCULATING PUMPS, installed immediately behind boilers, are of double-suction horizontal split-case design, with 450 gpm capacity each. System is designed so that at least one pump is operating at all times, insuring continuous hot water circulation through underground distribution system



SIX BOILERS, each rated at 350 boiler hp, may be fired slightly over 150 percent of rating for total of 3300 boiler hp. Units use No. 6 fuel oil, can be fired in sequence No. 1 through 6 or in reverse. Each boiler has own fuel storage tank, oil heater, induced draft fan and chimney

each building reduces the supply water temperature below 130 F as the outdoor temperature rises.

Heating Is From Above and Below

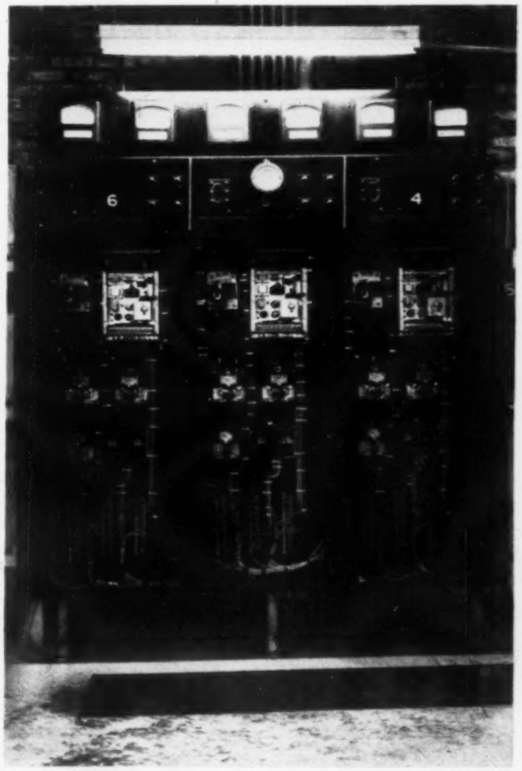
Floor and ceiling radiant panels are designed to distribute roughly one-half of the output upward and the other half downward. Each dwelling, therefore, is heated both from above and from below.

The radiant grids are made of type "L" copper tubing, ½ in. in diameter, installed in the concrete floors and ceilings. Tubing was installed on the wooden forms for the concrete slabs and attached to the reinforcing rods to prevent sags. Galvanized chairs are used where necessary to support the tubing between spans. Joints were soldered, then before the concrete was poured each circuit was blown out with CO_2 at a pressure of 250 psi. That pressure was maintained while reinforcing was placed, concrete was poured, and until the slabs had set.

Control Is Also Individual

The various apartment buildings have individual outdoor-indoor control systems. Circulating pumps are started and stopped automatically by outdoor thermostats, located on the north walls. One of the two pumps will continue to operate until the outdoor temperature reaches 65 F. The second pump is cut in whenever the outdoor temperature falls to 25 F.

Each apartment is equipped with manual shut-off



CONTROL PANEL for boilers 4, 5, and 6 is matched by similar panel for remaining three units valves and balancing valves, and to insure the circulation of at least some hot water even when the former is turned off, a perimeter "wild" coil is installed that cannot be controlled by the tenant. This prevents freezing of perimeter tubing installed next to the outdoor balcony slabs, which act as huge heat transfer fins.

Operating Results Prove Economy

The following operating results indicate that economy was in fact attained. No. 6 fuel oil consumption for the 1921 apartments between September 15, 1959 and June 15, 1960 was 165,950 gal. The 9227 rooms in the project, which cover a total heated floor area of almost 2,000,000 sq ft, were thus supplied with heat at a considerably lower consumption-per-sq-ft value than are comparable apartment buildings heated by other systems.

Typical operation of the heating systems follows the design objectives very well, as indicated by this data for March 5, 1960:

a) Outdoor temperature (7 a.m. to 3 p.m.)	16 F maximum 9 F minimum
b) Boiler water temperature	190 F
c) Water temperature, outlet from heating plant	184 F
d) Water temperature, inlet to heating plant	145 F
e) Oil temperature to burners	175 F
f) Oil consumption, 8 hrs.	2950 gal.

The average control temperature in the apartments ranges from 70 to 85 F, depending of course on tenant desires.

Operations Aid Efficiency

Various operational procedures have been adopted in order to insure a high degree of efficiency. Fuel oil is preheated to about 180 F by separate steam boilers, and an additive is introduced at the rate of one quart for every 1000 gal to prevent settlement of foreign matter and water.

The burners have been modernized to prevent shaft seal failures by filling each shaft case with oil to a point just below the bottom of the shaft. Bearings are lubricated with oil mist pickup from the oil case. No failures have been experienced since this procedure was initiated.

Water quality is checked once each week to make sure that the pH value is maintained at approximately 9.0, as a corrosion prevention measure. CO_2 recorders at the boiler outlets are connected with plastic tubing to prevent corrosion.

Each boiler is opened and cleaned after 16,000 gal of fuel have been burned. Tubes are scraped and the boiler is blown down, so that wear on each unit is equalized. At the end of each heating season, all boilers and expansion tanks are opened and cleaned, the boilers are treated, and left open until start-up.

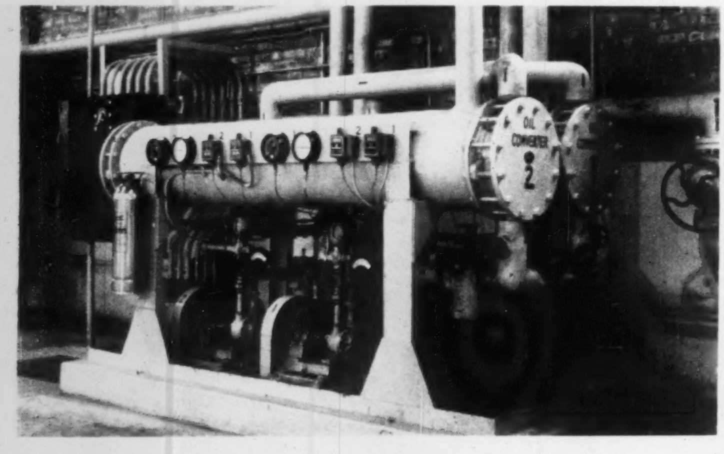
Stress Maintenance, Safety

For operational safety, an annunciator system for the pumps in each building is designed to sound an alarm at the main heating plant should any of the pumps fail.

The radiant heating system in the apartment buildings has completely eliminated the extensive cleaning programs required for exposed types of heating units, and has also done away with the problem of repairs to damaged exposed units and piping.

Refuse disposal, which in a project of this size is a considerable problem, is handled by individual gas-fired incinerators in each building. Refuse collection shafts are equipped with sprinkler systems for fire protection, and each incinerator has a timer to prevent over-firing and to save on gas consumption.

Since the initial installation, the refuse-chutes fire protection system has been converted to completely automatic control with the addition of a bimetal control-solenoid valve device. Sprinklers will start when the chute temperature becomes excessive, and will be shut off automatically when flames are extinguished and the bimetal control cools. ‡



FUEL OIL preheaters are provided for each boiler. System for each boiler-burner unit is completely independent, from fuel storage through transfer to combustion, venting, and hot water distribution

• **Professional tools can be used with greater ease and more effectively if basic conceptions are kept clearly in mind. The familiar psychrometric chart is such a tool. Here is a review which explains the fundamental meaning of sensible heat percentage and cooling lines which the engineer will impose upon the chart in the process of coil selection — as applied to a simple case of choosing the proper unit to cool a single space. Included are some refresher comments on the use of coil selection tables and the interpolation approach to the problem of matching available coils with tentative design conditions.**

Mr. Stevens is registered as a professional engineer in South Carolina, Georgia, and Pennsylvania.

Simplified case explains the basic concepts of

Cooling Coil Selection By Psychrometric Chart

By GEORGE C. STEVENS
Professional Engineer

MUCH has been written concerning the lines on a psychrometric chart and the phenomena which occur in the air conditioning process. One such comparison, frequently made, involves the case of air flowing through a direct expansion cooling coil, after which it enters a room to absorb heat and moisture from the room air. However it is not easy to visualize the relation between the actual physical occurrences of heat and humidity absorption and the representation of those occurrences by the lines of the chart.

A slightly different explanation of these relationships may help to clear up certain obscure points.

Let us assume that a room is gaining a certain amount of sensible heat and moisture (latent heat) over a given period of time, and that we are to counteract the heat gains by means of an air conditioner with a direct expansion cooling coil.

For simplification, we shall assume initially no ventilating air and no duct work. The machine is simply placed in the room and air circulated through it.

Air must emerge from the machine in such volume and condition that it will absorb the sensible heat and moisture gains at exactly the rate of room heat gain. We are not concerned about the sources of heat and moisture in the room except that none of the heat of evaporation must come from the room air itself. It may come from people, from a pot of boiling water, or other such source.

Start With Absorption

The line representing the latter part of the cycle, when heat and moisture are absorbed into the cooled air, is frequently called the "sensible heat percentage line," and should be established first. On this line depends the selection of the cooling equipment.

The line itself does not represent a cooling process in the same sense as does a "cooling line." It merely establishes, by its slope, the *ratio* between the amounts of latent and sensible heat gained by the room (per unit of time) and therefore, the ratio of the amounts which one increment of cooled air must absorb into itself to counteract the room heat gains.

This line extends from the room design condition point on the chart, to some point on the saturation curve where wet bulb and dry bulb temperatures are equal. Or, this line may never intersect the saturation curve, depending upon its slope.

The sensible heat percentage line is the locus of all combinations of wet and dry bulb temperatures at which a supply of cooled air can enter a room and absorb the room heat gain exactly as fast as it occurs. Therefore, the air conditioner should cool the air from the existing room condition to some point on this locus line.

Rate Is Next Factor

If the point representing the leaving or discharge air condition does not fall somewhere on the sensible heat percentage line, sensible and latent heat will not be removed from the room in the proper proportion to each other.

Just *where* on the line the point will fall depends on how fast the air is circulated through the air conditioner, or we might say, how many increments per minute are circulated.

The slower the circulation, the cooler will be the supply air, or in other words, the greater will be the temperature drop. Therefore, the more slowly air passes through the machine, the nearer will be its

cooling coil selection by psychrometric chart

leaving condition to the saturation point.

There are several ways of plotting this locus line, but one seems to demonstrate the idea of moisture relations more clearly. The formula is based on the fact that the number of grains of moisture to be absorbed, per lb of dry air, per degree difference (dry bulb) between supply and room air, equals the ratio of latent heat gain per hr to sensible heat gain per hr times 1.6, or

Gr per lb diff/F diff = (latent gain per hr/sensible gain per hr) 1.6

The derivation of this formula is from common equations long used in air conditioning practice and most familiar.

With the help of this formula, we can proceed to draw our line by using the scale of "grains of moisture per lb of dry air" at the right of the psychrometric chart. Obviously a chart which uses the grains scale in lieu of "lb water per lb of dry air" must be obtained.

Suppose the grains per lb difference per degree difference amounts to 0.25×1.6 or 0.4. This would be the case if the latent heat gain were 25,000 Btu per hr, and the sensible heat gain 100,000 Btu per hr, 25,000/100,000 being 0.25.

From the point of room conditions, say 80 F DB and 67 F WB, the line will extend towards the left on the chart, and down at the rate of 0.4 grains per lb for every 1 F DB decrease in temperature; or 8 grains of drop for every 20 F DB decrease. The line will extend to the saturation curve.

This is the line which is the locus of all conditions of supply air which can absorb heat from the room in just the right proportions of latent to sensible heat.

At any point on the line, the relation of WB to DB temperature will be such that the supply air will absorb latent and sensible heat from the room in the same proportions in which the room gains such heat.

Consider Volume Next

The volume of air circulated must be great enough to handle all Btu that must be absorbed, without too great a change in temperature.

A small amount of relatively cold air will accomplish almost the same result as a large amount of warmer air. However, colder air must be better diffused to prevent drafts, but warmer air will require a larger machine at a corresponding increase in cost. Good practice requires a satisfactory compromise between these two extremes. A 15 to 20 F temperature differential is generally used.

If a coil could be obtained which would give exactly the temperature drop desired, we could assume a 20 F temperature drop and calculate the cfm to be circulated with the formula

cfm = 100,000/(20) (1.08) = 4625

A coil face area of 10 sq ft would yield a face velocity of 463 fpm. But we do not know what exact temperature drop to use. The final coil selection will rest on a consideration of all the factors involved.

Velocity Sets Coil Temperature

Assume a coil contains refrigerant at a temperature of 40 F, and that the room conditions are again 80 F DB and 67 F WB. The dew point of such air is 60 F.

If we could pass air through the coil at sufficient velocity so that heat from the air would flow over the tubes as fast as the refrigerant could carry it away, the surface temperature of the coil would be 80 F.

Conversely, if air passed through the coil at an extremely low velocity, the refrigerant might absorb heat and carry it away so fast that the coil surface temperature would approach the temperature of the refrigerant, 40 F.

At any velocity between these extremes, the coil surface temperature will fall somewhere between room condition of 80 F and refrigerant temperature of 40 F. This will be an average temperature, with some tubes colder and some warmer. The supply air temperature will also be an average, somewhat higher, with some parts of the air stream warmer than others.

Unless the velocity is very high, some of the air will be so exposed to the coil that its temperature will reach dew point, or 60 F, and moisture will be precipitated on the coil, even though the average air temperature may be above the dew point. Also, at least a part of the coil surface must be at a temperature below the dew point, or no moisture will be precipitated.

It can be seen then that the *time* required for the air to give up its heat to the coil is a prime factor pertaining to coil design. Coil depths and face areas must bear such relationships to each other that air volumes will be great enough to contain the heat loads, while velocities are kept low enough to allow sufficient time for heat to be surrendered, and to prevent excess friction load and moisture carry-over to the air stream.

Note Important Variables

So with regard to the cooling problem, of the number of variables which must be considered, the most important are the face area, depth, and heat transfer efficiency of the *coil*, the entering and leaving conditions and volume of *air*, and the temperature of the *refrigerant* within the coil. Air velocity through the coil is established by face area and air volume.

In general, a psychrometric chart cooling line originates from the point of room conditions, and drops at an increasing slope as it approaches the saturation curve. This indicates that the rate of moisture precipitation, per F drop in dry bulb temperature, increases as the air becomes more moist. There is a different cooling line for every set of conditions.

Begin Coil Selection Process

For a coil to satisfy our requirements, one of its cooling lines must terminate on our sensible heat percentage line, at a point that will provide satisfactory economic and performance results.

Imposition of the cooling and sensible heat percentage lines on the psychrometric chart will show how a coil suits a particular problem. Assume the DB and WB temperatures and heat loads as before. Drawn correctly, the sensible heat percentage line will intersect the saturation curve at the point of 56.5 F, at which DB and WB temperatures are equal. This is line *AB* in Fig.1. We do not know as yet what portion of *AB* will represent the actual temperature rise of the chilled air increment after it enters the room.

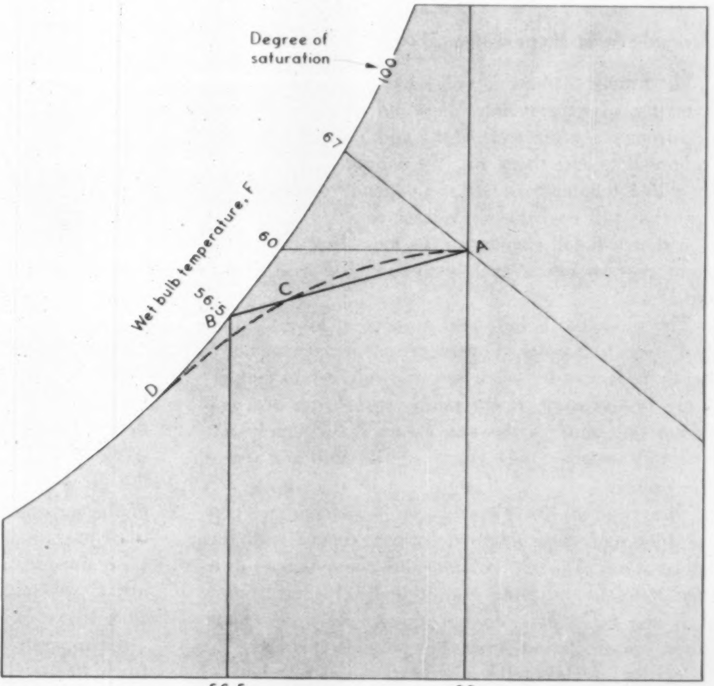
The cooling graph for a particular coil would be a curve similar to *ACD* in Fig. 1, with *C* being the point of intersection with the sensible heat percentage line. *CD* shows the ultimate path the cooling line would take if air velocity were reduced to zero, or the coil surface area increased to infinity, at which point the leaving air would be saturated, and its DB temperature would equal the refrigerant temperature.

This is merely a conception. In actual practice, the cooling line would be drawn from *A* through *C* to *B*, with *B* representing the average surface temperature of the coil. Air temperature would approach this point if the surface temperature of the coil were uniform at this value. Then the cooling line would coincide with the sensible heat percentage line. Point *C* would be obtained from cooling coil performance tables, as will be explained presently.

Actually, the surface temperature of a coil is by no means uniform, and for this reason the temperature of the air leaving a coil really approaches a point somewhat below *B*, on the saturation curve. For practical purposes, however, the straight line *ACB* is adequate.

Tables Aid Selection

Manufacturers' catalogs provide a wide variety of coil tables for individual and packaged coils to be used over a wide range of conditions. Many also give examples which illustrate selection methods. In general principle all methods are essentially alike. Given DB and WB temperatures of room air, coil face



1 COOLING GRAPH for any particular coil would be curve similar to *ACD*, which intersects sensible heat percentage line *AB* at point *C*. Point *B* is saturation, at which dry bulb and wet bulb temperatures are equal. Text explains how, in actual practice, cooling graph for specific coil would be drawn from *A* through *C* to *B*, with *B* representing average surface temperature of coil. Point *C* on that line is obtained from cooling coil performance tables areas and velocities, types of coil construction, and specified refrigerants at stated temperatures, the tables will yield leaving DB and WB temperatures and the coil capacities.

For the problem at hand, we seek a unit which will produce the right capacity in tons, when the supply air condition falls on our locus line at a point that will result in satisfactory overall performance and economy.

Air temperature drop within the coil should be great enough for efficiency, but low enough to preclude drafts. The 15 or 20 F temperature differential mentioned before will usually produce a condition of 80 to 90 percent relative humidity. A coil which produces such a differential, at a good face velocity, will usually be economical.

Face velocity is the governing factor. If it's too low, the coil face area will be unduly large. However, velocity should not be too high, or condensed moisture on the coil surfaces will be picked up by the air stream and carried into the room. About 500 fpm is a safe maximum velocity under ordinary circumstances, but this value may be exceeded, of course, if there is a good guarantee of satisfactory performance at a higher velocity. Generally speaking, refrigerant temperatures tend to be higher at the lower coil face velocities, and this results in good economy in compressor price and power consumption, since the higher the refrigerant temperature, the less compression is required. Higher face velocities permit the use of coils of lower initial cost.

Procedure Is Experimental

The practical phase of coil selection is pretty much a matter of experiment. Many units will fulfill the requirements after a fashion, and it requires good judgment to sort them out. We cannot merely decide on a 20 F temperature rise and depend upon finding a unit that will cool the air volume to a leaving condition that will fall exactly on the locus line and at the point corresponding exactly to the 20 F rise (60 F DB.)

The objective is best performance at lowest initial and operating costs. Consideration of face velocity, depth, heat transfer efficiency, and refrigerant temperature is necessary. If the temperature drop of a coil is not the same as the rise assumed for supply air, one must assume a new rise to suit the unit and repeat the process.

The cooling line depends on a mechanical contrivance and data obtained by experiment with this contrivance. The air volume and room temperature rise must be adjusted conditionally for each unit.

If the table data do not exactly suit our conditions, interpolation may be possible between air velocities, refrigerant temperatures, and numbers of rows in the coil to expedite the selection.

For a given number of coil rows, if adequate compressor capacity and a variable speed fan are provided, the refrigerant temperature and air velocity can be adjusted over a fairly wide range of values in order to obtain the desired conditions. The packaged type of air conditioner which is widely used usually has such a range.

Room heat gains will vary widely throughout the day, and even though the equipment will normally operate at partial loads the unit must have adequate capacity to handle the maximum load anticipated.

Ventilation Is Also Needed

We have neglected the introduction of outside air up to this point for simplification. However, ventilation air is always required in comfort cooling, and must be considered.

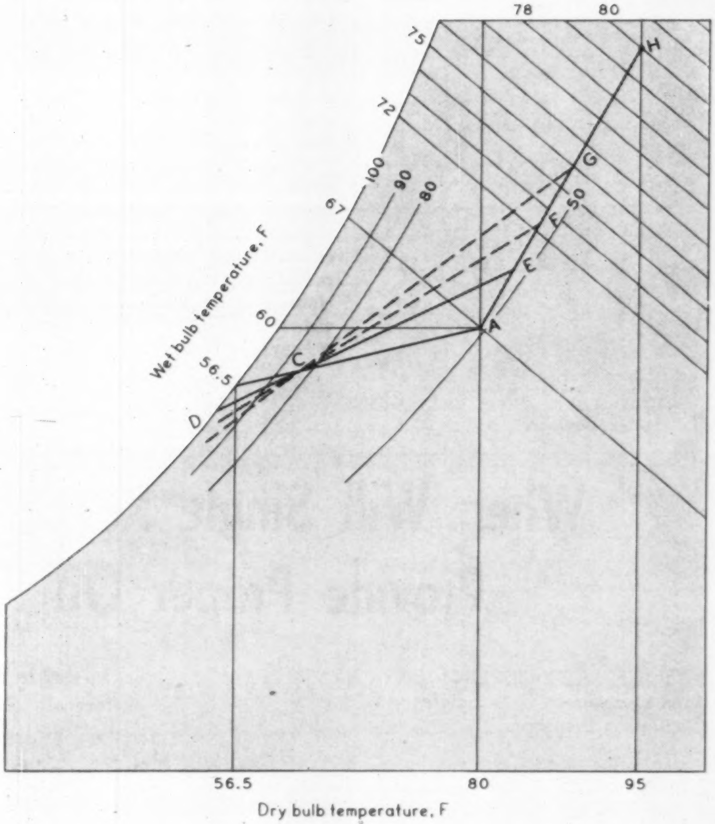
Outside air may be admitted either directly to the room or directly to the air conditioner. The better method is through the machine. Otherwise, chilled air volume must be greater, or its temperature lower, or both. If outside air is mixed with return air just prior to cooling, the cooling process can start at the mixture temperature instead of at room temperature, thus permitting a higher refrigerant temperature. Furthermore, direct introduction to the room will result in a lower room sensible heat percentage (steeper locus line) and generally lower supply air WB temperature.

Regardless of the method used for ventilation, some opening must be left for an equal quantity of air to escape to the outside, and cracks around doors or windows cannot always be depended upon for this purpose.

Start At Mixed Air Temperature

The cooling line for an air supply which is a mixture of return and outside air originates at the mixture temperature instead of at room temperature. Otherwise the principles previously stated for the cooling graph all apply.

The process of absorption of heat from the room will start where the cooling line intersects the locus line, as before. It will still end at room temperature, however, and not at mixture temperature. The rise from room air temperature to mixture temperature is the result of blending room air with outside air in the mixing chamber of the machine. The temperature of the air within the mixing chamber approaches that of the outside air in direct proportion to the quantity of outside air introduced. If the total air supply is from outside, its temperature is that of the outside air. If the mixture is half and half, its temperature is halfway between room temperature and outside air temperature. If the outside air volume is one-tenth the total supply, the mixture temperature will be greater than room temperature by one-tenth the



2 CALCULATIONS to include outside air supply for mixture with return air, and coil selection under those circumstances, are illustrated at right. *CA* is the locus, or sensible heat percentage line; *CE* the cooling line; *AH* the line on which outside and room air are blended, with *H* representing design condition of outside air. Point *D* is condition which mixed air approaches as it flows through the coil, and is average surface temperature of coil. Lines *CF* and *CG* represent positions cooling line would assume if ratio of outside to room air were increased

number of F difference between room and outside temperatures. It is as simple as that.

Summarize Calculation Method

The procedure for calculating an air supply which includes some outside air can be summarized as follows:

1) Assume a supply DB temperature, and from it, the temperature rise to room conditions. This will also establish the supply WB temperature, since the point indicating the DB temperature will be on the locus line.

2) Calculate the air quantity for this rise within the room by the formula

cfm = (sensible heat gain per hr)/(F difference) (1.08)

This will be the total air quantity to be cooled.

3) From this quantity as a total, including the amount of outside air to be introduced, calculate the mixture temperature.

4) Select a coil which will produce as nearly as possible the supply air conditions assumed, using the mixture temperature and the calculated cfm. If the unit considered does not come close enough to meeting the desired conditions, assume a new temperature rise and repeat the procedure. With practice, only a few tries will be needed to make the match.

This procedure will yield lines on the psychrometric chart similar to those shown in Fig. 2.

The line *CA* is the locus, *CE* the cooling line, and *AH* the line on which outside and room air are blended. Point *H* represents the assumed design condition of the outside air; point *E* the mixture condition. Point *D*, on the saturation curve, indicates the condition which the mixed air supply is approaching as it flows through the coil, and is the average surface temperature of the coil.

Lines *CF* and *CG* indicate positions which the cooling line would assume if the ratio of outside air to room air were increased. Points *F* and *G* represent what the mixture conditions would be in these cases.

These are the fundamentals of calculating a conditioned air supply and selecting a cooling coil to provide it. We have intentionally avoided discussion of variations in the problem such as extremely high latent heat loads requiring very low DB temperatures for moisture removal and subsequent reheat, in order to restrict our consideration to the basics of the air cooling process and its relation to the psychrometric chart.

This is only a fractional part of air conditioning design, but a most important fraction. ⌗

• Double refrigerant risers have long been used for suction and discharge lines in systems with variable capacity compressors. This was the "safe" or conservative approach — used to insure positive return of lubricating oil from the piping back to the compressor. Double risers assured a high enough velocity to carry the oil even when compressor capacity was reduced to a minimum. The accompanying charts combine the variables of compressor capacity, system pressure loss, design temperatures, and *critical velocity* to permit an easy determination of riser size to produce proper oil return. Equally important, the charts will show when single velocity risers can be used without adverse effect on the system balance.

When Will Single Refrigerant Risers Provide Proper Oil Return?

By JOHN P. JOHNSTON
John P. Johnston & Associates
Consulting Engineers

A FEW years ago, data available on the subject of oil return in refrigerant piping made a decision to use double risers in systems with automatic-capacity-control compressors appear rather conservative.

At that time, it was generally accepted that suction and discharge gas velocities of less than 1500 fpm in vertical risers would not suffice to insure that compressor lubricating oil which leaked to the piping would be returned through the system to the compressor.

Thus, for variable capacity compressor systems, where unloading of the compressor in stages would reduce the volume and thus the velocity of gas through the risers, double risers seemed to be the "cautious" approach. Double risers provide one pipe of proper size to accommodate the minimum capacity at minimum recommended velocity, combined with a second pipe of such size so that the two together will handle the maximum volume.

Assured oil return for all such systems by means of double risers was a proven fact.

More recently, tests conducted by Professor Norman Sharpe of California State Polytechnic College have involved the use of single velocity risers at the suction outlet of direct expansion coils and heat exchangers.

The results of these tests have confirmed certain other available data related to recommended minimum tons of refrigeration capacity (gas volume) to be carried by a suction riser in order to insure satisfactory oil return.

Single Risers May Not Suffice

With what we now know, it appears that the "conservative" double riser approach may not have been so conservative after all. In fact, what follows will show that in a system with variable capacity compressor, single velocity risers will operate satisfactorily from the coil and compressor outlets to the suction and discharge mains *only* if such risers are not of too great a length.

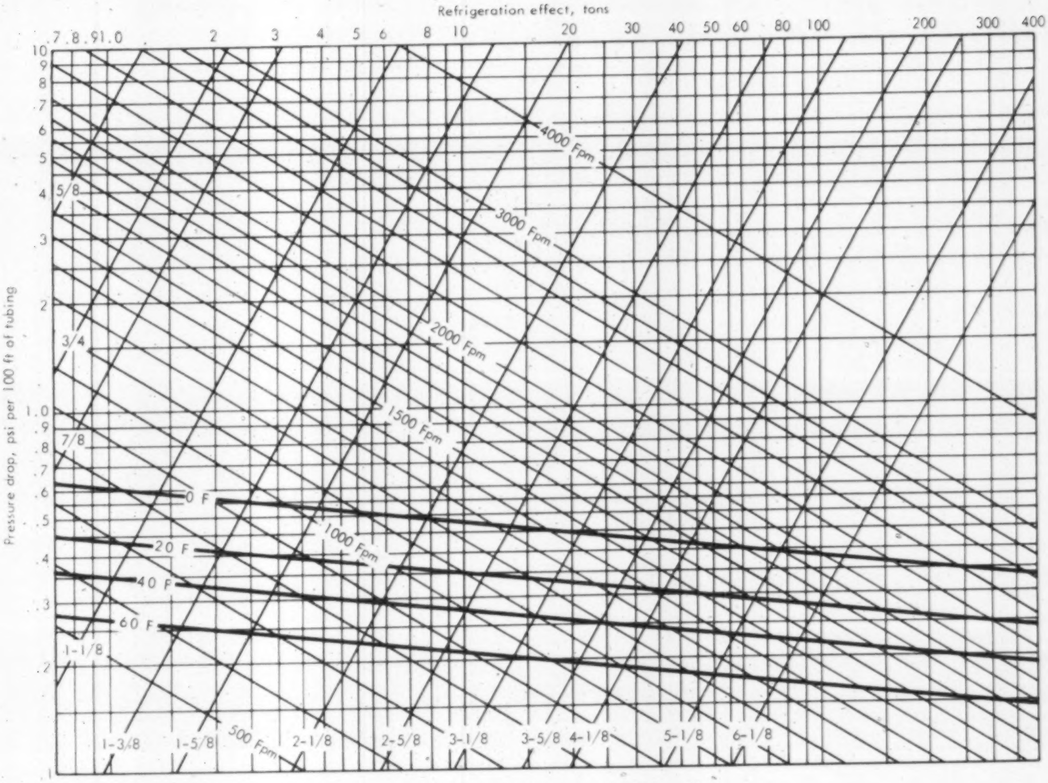
Otherwise, an intolerable pressure loss can be expected. Under these conditions, therefore, a return to the old standby of double risers is the only workable solution to the problem of restricting pressure drop within allowable limits.

Concurrently, however, the procedure described here will allow the engineer to make a precise judgment on exactly *when* or at what point the length of the risers will require the double pipe design.

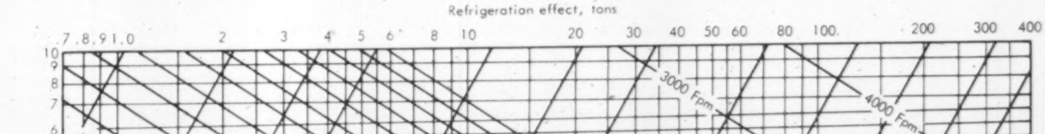
Earlier Data Develops Limits

Basically, Professor Sharpe's tests were conducted using a suction riser of 1 in. diameter, incorporating a trap at its base and using refrigerant 12 at temperatures of 22 and 50 F.

Among other things, the tests proved that satisfactory oil return was possible at riser gas velocities of 600 and 670 fpm. This coincides with some other recommendations concerning minimum pipe sizes



1 REFRIGERANT 12 suction gas pressure drop in Type K copper tubing



2 REFRIGERANT 12 hot gas pressure drop in Type K copper tubing

single or double refrigerant risers?

for suction gas risers used with refrigerants 12, 22, and 500.

While it is nowhere stated in the published results, there is reason to believe that the condensing temperature in all test cases was 105 F. It is important to note that in the use of such data, and in an analysis of the problem at hand, the level of condensing temperature is of considerable moment, as will be demonstrated later.

How Graphs Are Constructed

Figs. 1 through 4 are plotted to show pressure drop (psi per 100 ft of equivalent pipe system length) *vs* refrigeration capacity of the system in tons, for the suction and discharge sides of systems employing refrigerants 12 and 22.

Figs. 5 and 6, for liquid refrigerants 12 and 22, are included to complete the family of curves.

The graphs incorporate the relationship of critical gas velocity to pipe size and nominal capacity in tons. Critical velocity factors are reflected as straight lines on log-log charts, and follow the general equation.

$$V_c = CT^{0.2}$$

where

V_c = minimum velocity for optimum oil return, fpm
C = constant
T = nominal tons of refrigeration capacity at standard operating conditions of 40 F and 105 F

Plotting such graphs in terms of tons is for convenience only, since in reality neither the piping, coil, nor compressor are aware of a "ton" of refrigeration. By "tons," we actually are defining the volume of gas circulated in various parts of the system, depending upon temperature and pressure from which velocity and pressure drop can be directly calculated.

Standard Conditions Must Be Modified

Insofar as the design or operating conditions vary from the assumed standard conditions of 40 F and 105 F, corrections must be applied to the nominal tons of capacity plotted on the graphs.

To determine the refrigerant weight to be circulated per minute to produce a refrigerant effect of one ton —

$$\text{lb/min/ton} = (12{,}000/60)\ (H_v - H_l)$$

where

H_v = enthalpy of vapor, Btu per lb
H_l = enthalpy of liquid, Btu per lb

For refrigerant 12, and the standard conditions of 40 F suction and 105 F discharge gas temperatures, the equation will result in

$$\begin{aligned}\text{lb/min/ton} &= 200/\ (82.71 - 32.40)\\ &= 3.975\ \text{lb/min/ton}\end{aligned}$$

This *weight* of refrigerant must be circulated in all parts of the refrigeration cycle, at this particular condition, but the refrigerant will vary in volume depending upon whether it is in the form of suction gas, discharge gas, or liquid[1].

By multiplying this weight flow (3.975 lb per min per ton) by the specific volume of the refrigerant at the suction, discharge, and liquid temperature conditions, the following volumes are obtained:

Suction gas: 3.148 cu ft per min per ton
Discharge gas: 1.185 cu ft per min per ton
Liquid: 0.051 cu ft per min per ton

If the system under consideration were to operate at 20 F and 120 F suction and condensing temperatures, respectively, then by this same equation

$$\begin{aligned}\text{lb/min/ton} &= 200/(80.49 - 36.16)\\ &= 4.511\ \text{lb/min/ton}\end{aligned}$$

would be circulated in the refrigeration cycle.

The volume of refrigerant in the various stages would be

Suction gas: 4.511 × 1.121 = 5.057 cu ft per min per ton
Discharge gas: 4.511 × 0.240 = 1.083 cu ft per min per ton

As compared to the standard conditions of 40 and 105 F, this would represent an increase of 60.6 percent in the volume of the suction gas, and a decrease in the volume of the discharge gas to 91.3 percent of the standard condition volume.

Data for Refrigerants 12, 22 Coincide

In computing volume relationships for refrigerant 22, it is interesting to note that they coincide so closely with the relationships for refrigerant 12 that for all practical purposes the values can be averaged, and a single graph constructed which will apply for both refrigerants. (Fig. 7)

In Fig. 7, the cu ft per min per ton values for non-standard operating conditions are expressed as ratios of standard conditions, in which R_s equals suction gas volume ratio and R_c the discharge gas volume ratio.

Graph for Non-Standard Conditions

Therefore, from Fig. 7, if a system were designed for conditions of 20 and 120 F, then in sizing suction gas risers from the graphs presented here the design tonnage must be increased to 160 percent—a factor of 1.6 × the design capacity.

Discharge gas tonnage will be 91.3 percent (0.913) of the design tonnage when applied to the discharge

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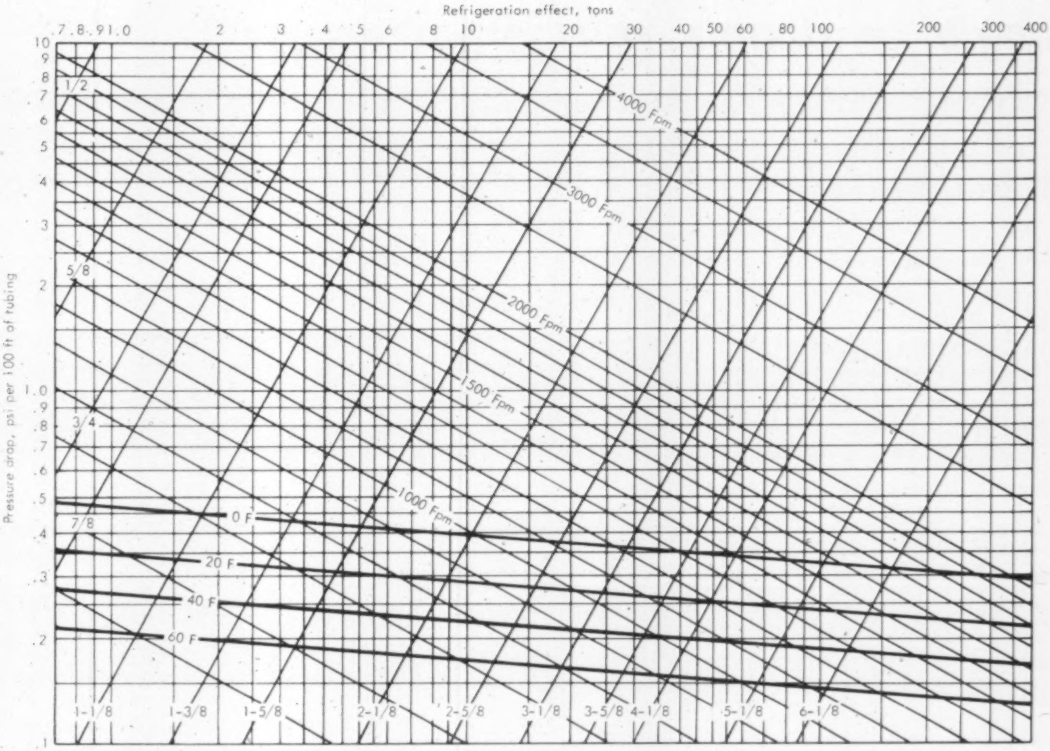
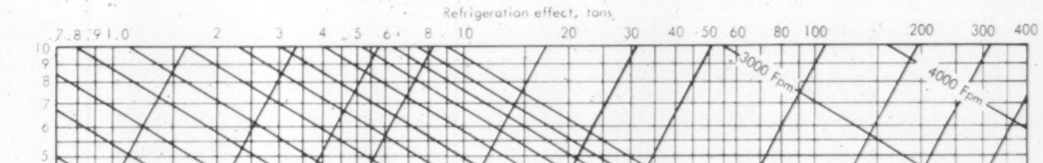
[1] *Values of enthalpy and volume are from data tabulated by Kinetic Chemicals, Inc., which we note vary slightly from data offered by some other refrigerant producers.*



3 REFRIGERANT 22 suction gas pressure drop in Type K copper tubing



4 REFRIGERANT 22 hot gas pressure drop in Type K copper tubing gas graph for the purpose of selecting the proper size discharge gas riser.

What Is the Constant?

Note that the constant C in the equation $Vc = CT^{0.2}$ can be expressed by

$$C = Y/k^{0.35}$$

where

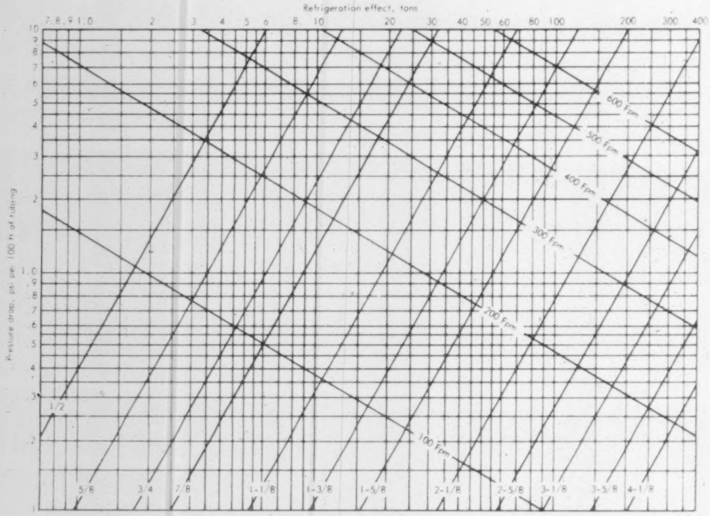
k = kinematic viscosity of the gas at the temperature condition, sq ft per sec

Y = 9.126 for refrigerant 12 up to 100 F
= 9.820 for refrigerant 12 above 120 F
= 7.806 for refrigerant 22 up to 100 F
= 8.435 for refrigerant 22 above 120 F

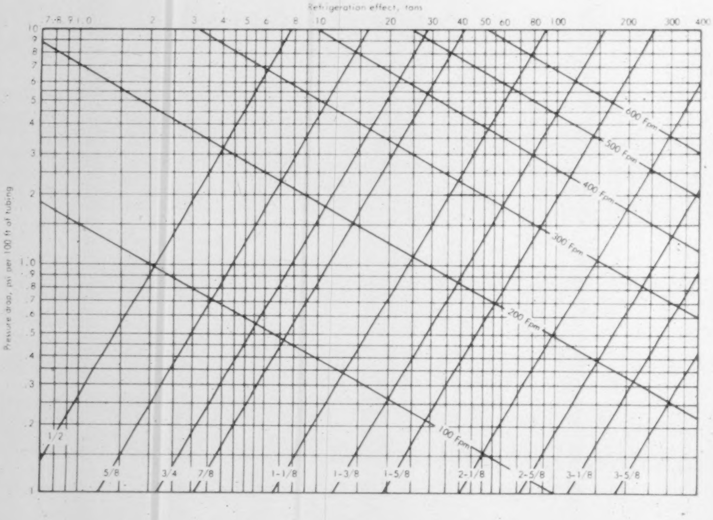
The values of k used here are taken from *Air Conditioning Refrigeration Data Book*, 1953-54 edition, p. 3-03. For some unknown reason, these values of kinematic viscosity cause a shift in the graphs (Figs. 7 & 8) between 100 F and 120 F as can be seen from the variation of the values of Y, above. There can well be some logical reason for this shift, but for our immediate purposes it is unnecessary to rationalize the phenomenon.

Reynolds Number Factors Included

The critical velocity curves on Figs. 1 through 6 incorporate the effects of density, viscosity, and diameter which are the factors employed in the determination of Reynolds Number. Thus this parameter, so important in a study of fluid flow and ther-



5 REFRIGERANT 12 liquid pressure drop in Type K copper tubing



6 REFRIGERANT 22 liquid pressure drop in Type K copper tubing modynamics, is fully considered in determining the proper size riser for the refrigerant at the design temperature-pressure condition.

In fact, a single plot of Reynolds Number *vs* refrigerant temperature may be constructed and will be correct for either refrigerants 12 or 22. It is obvious then that no single value of critical velocity can be correct for a variety of pipe sizes and temperature conditions.

Oil Flow In Discharge Lines

While published data to date has dealt mainly with the return of oil from the evaporator to the compressor, it is our opinion that a form of the same problem exists in carrying oil away from the compressor once it has passed through the discharge valves.

As an extreme, we are certain that if a discharge pipe of infinite size were installed, it would in time fill sufficiently with oil to damage the compressor.

Though, as may be seen by inspection of the charts, the critical velocity for discharge gas is much lower (as is expected in view of the higher oil carrying capacity,) there will arise a condition at which the oil cannot be lifted in a discharge gas riser. Therefore the same careful consideration must be given to the design of the discharge gas risers as is accorded the suction riser design. The need for special evaluation of all gas risers will exist in any system with a variable compressor capacity.

How To Use Charts

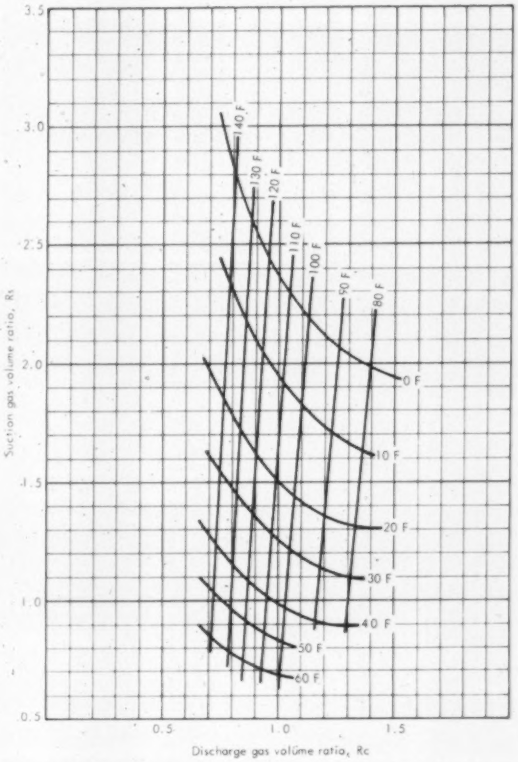
To use these charts (Figs. 1 through 4) enter the graph vertically at the desired tonnage to an intersection with the gas temperature line. This point represents the minimum velocity that must be maintained for the proper return of oil, and the proper riser size will be either on or above this point on the chart.

The following example will illustrate the full use of the charts.

Assume an installation with a variable capacity compressor, using refrigerant 12 to produce a refrigeration effect of 60 tons at conditions of 55 and 115 F, and with an unloading sequence of 25, 50, 75, and 100 percent.

From Fig. 7, *Rs* equals 0.8 and *Rc* equals 0.9. This means that as compared to standard conditions of 40 and 105 F, the volume of the suction gas will be reduced to 80 percent and the volume of the discharge gas will be reduced to 90 percent. Therefore in the present problem, to correct for the variation from standard conditions:

60 × 0. 8 = 48 tons (suction)
60 × 0. 9 = 54 tons (discharge)



7 VOLUME RELATIONSHIPS for refrigerants 12 and 22

Likewise, in considering the flow at minimum capacity:

48 × 0.25 = 12 tons (suction)
54 × 0.25 = 13.5 tons (discharge)

These are the capacities for working conditions. Concurrently, an engineering judgment would be made concerning the maximum allowable pressure drop (Δp) for the risers which will permit an economical pipe selection.

In Fig. 1, entering at the 48 ton capacity, if we first consider a 3-1/8 in. pipe, this size will result in a velocity of 3400 fpm and a pressure drop of 2.0 psi per 100 ft equivalent pipe length. Next it can be determined that this 3-1/8 in. pipe size will yield a gas velocity of 820 fpm at minimum compressor capacity of 12 tons.

The intersection of the 12 ton coordinate with the suction temperature line (55 F), however, shows that a velocity of not less than 960 fpm must be maintained in a vertical riser to effect proper oil return, and therefore only a 2-5/8 in. pipe (or smaller) will satisfy this requirement. The velocity in the 2-5/8 in. pipe at 12 tons capacity will be about 1200 fpm, well above the required minimum.

Return to Maximum Capacity

How will the smaller pipe size affect system opera-

single or double refrigerant risers?

tion at maximum capacity? The intersection of the 48 ton line and the 2-⅝ in. pipe curve yields a pressure drop of 4.7 psi per 100 ft, with a velocity of 4400 fpm.

Thus it can be seen that the selected single velocity riser will operate satisfactorily from the coil into the suction main only if it is not of too great a length.

If the riser were of an equivalent length of, say, 10 ft, a loss of 0.10 ×4.7=0.47 psi will be experienced in the suction riser, but an equivalent length of 50 ft will yield a pressure drop of 2.35 psi.

What About Discharge Risers?

Similarly, the maximum volume equivalent of 54 tons in the discharge gas riser of 2-⅝ in. size (Fig. 2) will produce a pressure drop of about 2.1 psi per 100 ft at a velocity of 1900 fpm.

At the minimum capacity of 13.5 tons and at a discharge temperature of 115 F, a minimum velocity of 720 fpm is required, and the 2-⅝ in. pipe falls short of this in that the velocity produced in a pipe of this size at 13.5 tons is less than 500 fpm.

Smaller Size Meets Requirement

If, on the other hand, the next smaller pipe size is selected (2-⅛ in.) the critical velocity is achieved. The intersection of this 2-⅛ in. coordinate with the maximum capacity (54 ton) line yields a velocity of about 3000 fpm, and the pressure drop at that condition is 6.1 psi per 100 ft equivalent length.

Again, the single velocity riser will be feasible only if the length is not too great. An equivalent length of 10 ft for the discharge riser will give a pressure drop of 0.10 × 6.1 = 0.61 psi at maximum system capacity.

Will Losses Be Too Great?

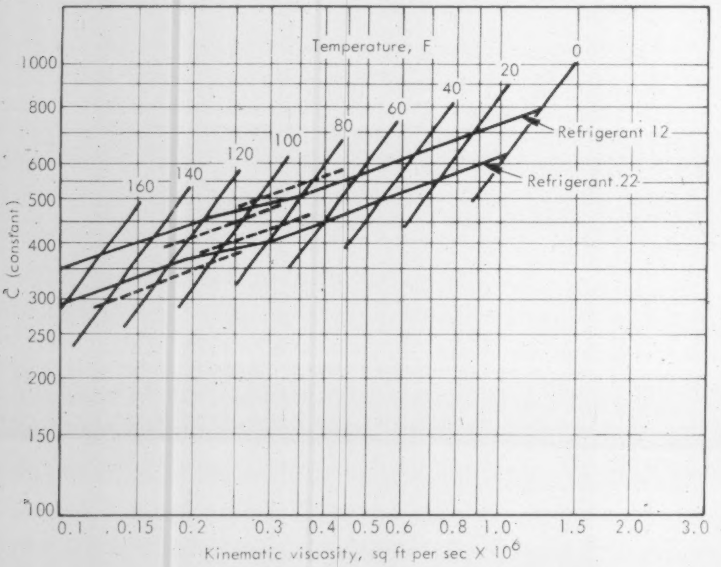
Depending, therefore, on the length of the rest of the piping, such losses may not be enough to affect the system balance. However, if the velocity risers are of an equivalent length of, say, 100 ft, then the 4.7 psi suction loss and 6.1 psi discharge loss cannot be tolerated.

If this is the condition, then the old standby of double risers is the *only* workable solution to the problem of maintaining pressure drop within allowable limits.

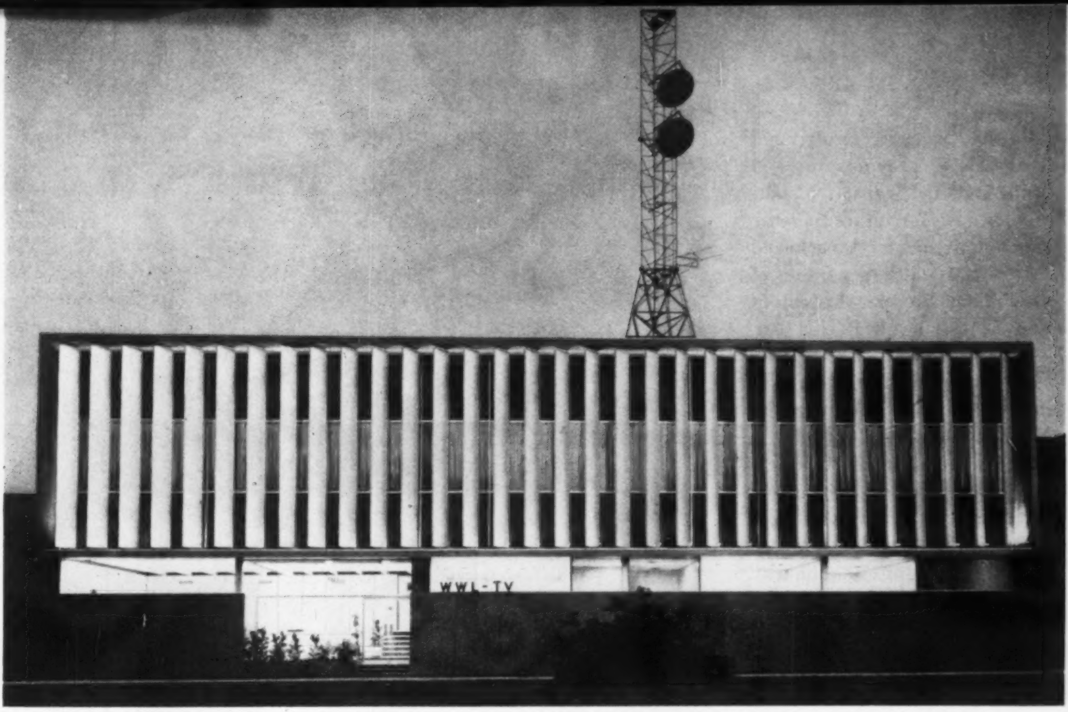
Charts Help To Design

The purpose of the charts presented here is to afford an easy means of determining when the single velocity riser will no longer suffice, or conversely, when the single riser will suffice and perhaps allow additional economies of design.

We are satisfied that while only certain portions of the graphs are absolutely substantiated by the available data mentioned earlier, the extensions of the data used to construct the graphs are correct, and can be used in determining velocity riser size for suction and discharge gas. ‡



8 PLOT of *C*, a constant, as a function of kinematic viscosity



TELEVISION STATION WWL-TV, owned and operated by Loyola University of the South, New Orleans, La.

Careful Heating-Cooling Design Keeps TV Station "On-the-Air"

By JOSEPH E. LEININGER
Consulting Engineer

THE DESIGN analysis for a television station air conditioning system will be influenced basically by the usual factors considered for any building with commercial type occupancy.

Certain specialized requirements, however, not usually so prominent in an ordinary building, complicate the problem somewhat.

Generally, these special considerations will take the form of an exaggeration of the following:

1) Variations in lighting and equipment heat gains.

2) Occupancy variations during a 24 hr period.

3) Temperature control requirements.

4) Supply and exhaust air needs for precision electronic equipment.

The more common elements in the design, of course, include indoor and outdoor conditions, the type of building construction and layout, proper air distribution, noise level considerations and vibration effects, and the necessary system reliability.

Design for New Station

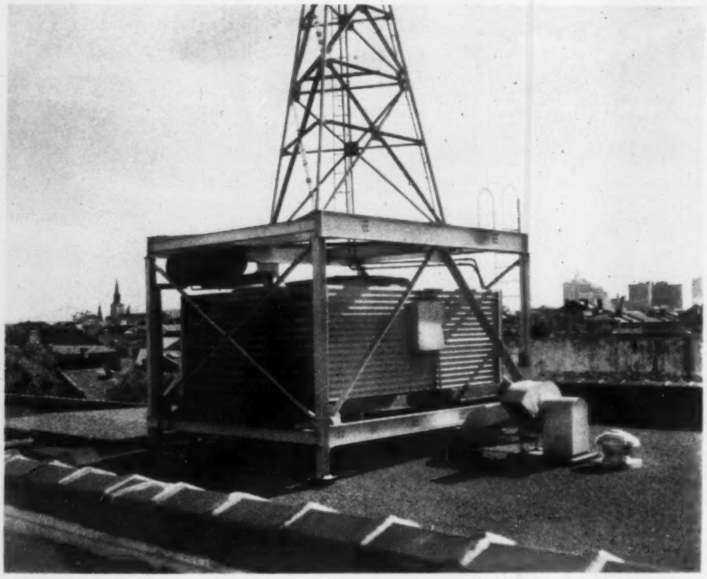
Television station WWL-TV, operated by Loyola University in New Orleans, first went "on the air" in September 1957. This in itself was an accomplishment, since by the previous May, only the drawings had been completed.

Actually, the facility occupies two sites — the studio building located on famed North Rampart St., and the transmitter building some 4 miles away in Gretna, La. The two are linked by a microwave system which actually passes under the new Mississippi River Bridge, which straddles the line of sight between them.

Cite Main Design Features

The basic air conditioning plan for the studio building includes

Here is a description of the heating and air conditioning systems which meet the specialized and stringent demands of the high internal heat gain problem within operating television studio and transmitter buildings. The system developed for WWL-TV in New Orleans has worked well for over three years, and has resulted in only minor suggestions for improvements.



INDUCED DRAFT cooling tower of 200 ton capacity is installed on roof of studio building on structural members which also support microwave antenna

two 75 ton capacity centrifugal chillers. These provide for 100 percent standby capacity, plus some allowance for future increase in load requirements. A packaged gas fired hot water generator of 1-1/5 million Btu per hr output capacity is also installed. This boiler is seldom, if ever, needed at full capacity, and is used principally to warm the building on unusually cold winter mornings.

No allowance is made for pickup or piping losses in the heating design because of the unusually high internal heat gain produced by the large amount of equipment.

A cooling tower of the induced draft type is installed on the roof. Rating for the tower is 200 tons, to cool 800 gpm of water from 95 to 87.5 F in an air temperature of 80 F WB. The tower jacket and top deck are of non-combustible construction, since the site is within the "inner fire zone" of the city.

One unusual feature is that the structural support for the cooling tower also serves as the base for the microwave antenna.

Table Gives Breakdown

Table 1 itemizes the various occupied areas within the studio building, and shows the division of single and multi-zone air conditioners used to condition each space, with the capacity of each. Various other equipment items such as hot water unit heaters, condenser water pumps, chilled and hot water pumps, and exhaust fans serve or complement this main system.

The pneumatic control system used in the building is worthy of special mention in regard to its service within the main operating studios Nos. 1 and 2.

A total of four thermostats are spaced around the perimeter of each studio area. The four act through three double diaphragm pneumatic relays, which are connected in series with each other as well as with the various thermostats. In other words, the first two thermostats are connected to the first relay, then the first relay is connected in series with the second relay, which is also connected to the third thermostat, and so on.

The cumulative effect of this arrangement is to position a three-way mixing valve in the chilled water supply to the cooling coil of the zone air conditioner, and a similar valve in the hot water heating supply.

This results in a "calculated risk" type of control, because of the fact that the whole studio comprises but a single zone. During the cooling cycle, the section of the studio which requires the *maximum* cooling affects the action of the nearest thermostat. This is the control point. Other thermostats in the studio will then be "inaffective," so that other sections of the studio will be overcooled.

Similarly, on the heating cycle, the section which requires the *minimum* amount of heat will govern the heating input, and the inaffective sections will be underheated.

Idea Works Well

During three years of operation, no complaint has been heard as a result of this control system. This is due to at least two factors.

TABLE 1 — VARIOUS TYPES of year 'round air conditioning units used in the several areas of the TV studio building are itemized below, with cooling and heating capacities of each

Area	Unit type	No. of zones	Volume, cfm	Cooling capacity, tons	Heating capacity, MBtuh
Studio No. 1	Single zone	1	12,000	45	285
Studio No. 2	Single zone	1	17,000	48	360
Control room	Multi-zone	6	8,000	26.5	45
9 to 5 offices	Multi-zone	4	11,000	23	290
24 hr offices	Multi-zone	2	5,000	10	160
Auditorium	Single zone	1	3,000	7	110

Since the part of the studio in use will be the section producing most heat from lights, cameras, etc., proper heating or cooling values are actually being maintained in the occupied portions. Other portions of the space are then being used only for access to or exit from this controlling section, and may be considered as transient spaces.

Besides this, the natural effect of varying air temperatures within the single space is to produce an equalization of temperature by convection, conduction, and radiation, in that order of importance.

Vary Duct Pattern

Supply and return air distribution design is based on the usual considerations of adequate air volumes without noticeable drafts, static pressure losses within the ducts, and quiet operation.

Circular aspirating type ceiling supply outlets are used in the studios, with ceiling return grilles. These supply outlets incorporate a special feature. An extended duct is attached to the diffuser and slotted on each side to receive a pin and wing nut from the ceiling duct extension. By this means, diffusers can be raised or lowered so as not to interfere with overhead lights and microphone booms.

In other areas of the building, sidewall supply air grilles or square ceiling supply outlets and sidewall return air grilles are installed.

Pattern Is Flexible

Interior partitioning in the first and second floor nine-to-five offices and in the 24-hour offices on the first floor is modular to provide for future variations in space use.

This led to the use of flexible round ducts, consisting of polyvinyl coated glass fiber fabric, mechanically locked with a supporting steel spiral. These lead from the fixed metal ducts serving general areas, to the various supply outlets. Thus the system is flexible enough to accommodate changing space patterns with a minimum of expense and effort.

All supply and return air ducts are lined with 1 in. of vinyl coated heavy density glass fiber. Sound attenuating boxes are installed within the main supply ducts serving the studios and the audio booths. No special sound treatment is used for return ducts. This arrangement has proved entirely satisfactory.

Isolate Noise, Vibration

Any possible vibration transmission from the two centrifugal chillers is precluded by their location in a separate frame building adjacent to studio 2. All equipment with moving parts is mounted on rubber-in-shear or sandwich type anti-vibration supports. No difficulty has been experienced with these relatively simple types of vibration control, even though the mechanical equipment room is so close to the studio.

Most of the equipment is supported directly by the first floor slab, which in turn rests on the ground, which contributes to the generally rapid attenuation. Piping connections to pumps and to the refrigeration machines are made with flexible couplings.

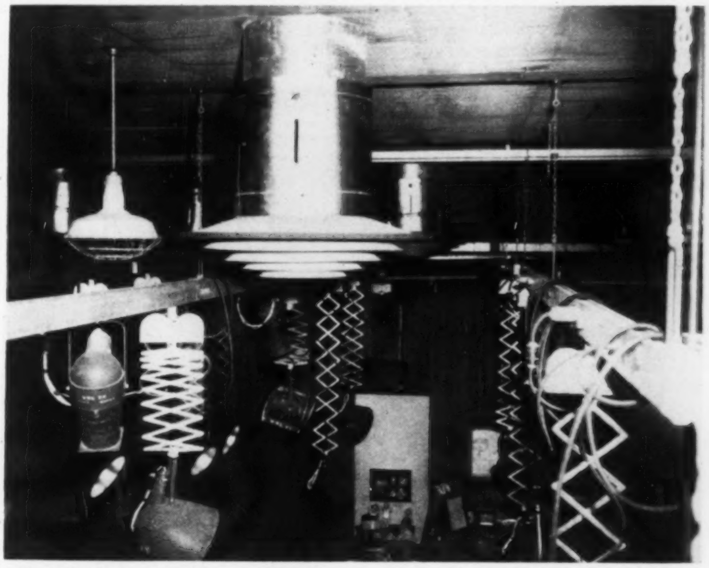
Equipment Ventilation

In the technical equipment area of the building, an exhaust air duct system is mounted directly above the top of the electronic control racks, with an inlet from each of the various rack cubicles.

About 125 cfm of exhaust air is removed from each of the 27 racks by means of an exhaust fan mounted on the roof. Air supply to each rack is via a crawl space, from studio 1 and from the first floor offices. Air is re-filtered before entry to the racks.

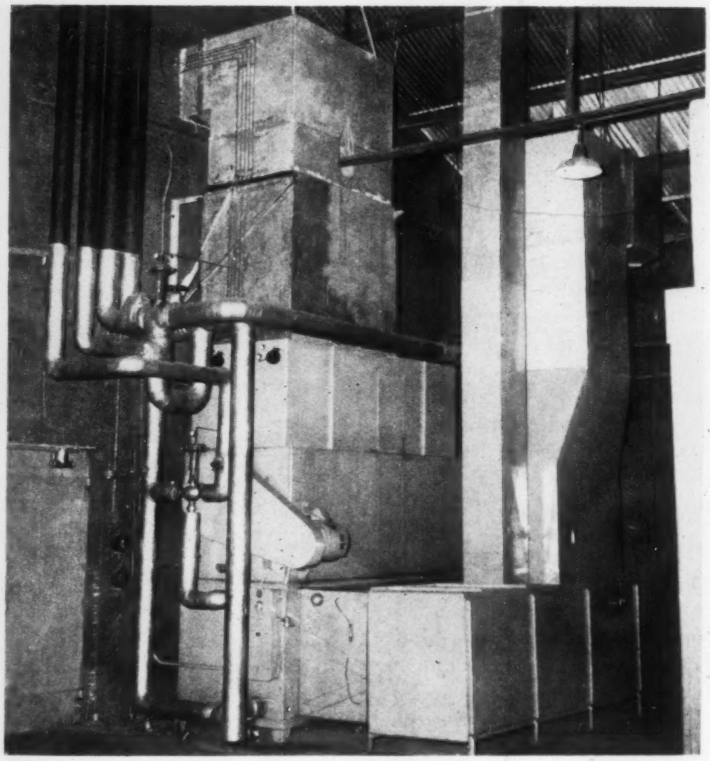
Condition Power Building

In Gretna, La., a 7.5 ton capacity unitary air conditioner with remote cooling tower and condenser water pump supplies cooled air to the office, work rooms, and control room of the transmitter building. Heating is by means of an electric duct heater, located in the supply air duct directly above the discharge air connection.



AIR SUPPLY to studios is through circular diffusers mounted on extendable ducts. Diffusers can be raised or lowered as needed to avoid interference with lights and microphone booms

AIR CONDITIONER for one studio is shown at right. Unit contains chilled water coils, is controlled by group of series-connected thermostats



Equipment racks in this building are served by a system similar to that used across the river, except that two fans are installed — one for each half of the space. Supply air is drawn from a plenum space beneath this area, after filtering by means of two electrostatic type air filters. An axial flow fan provides air supply from the filters to the plenum space. Four centrifugal fans draw air from the plenum for the equipment racks, and also for the transmitter room.

Suggest Improvements

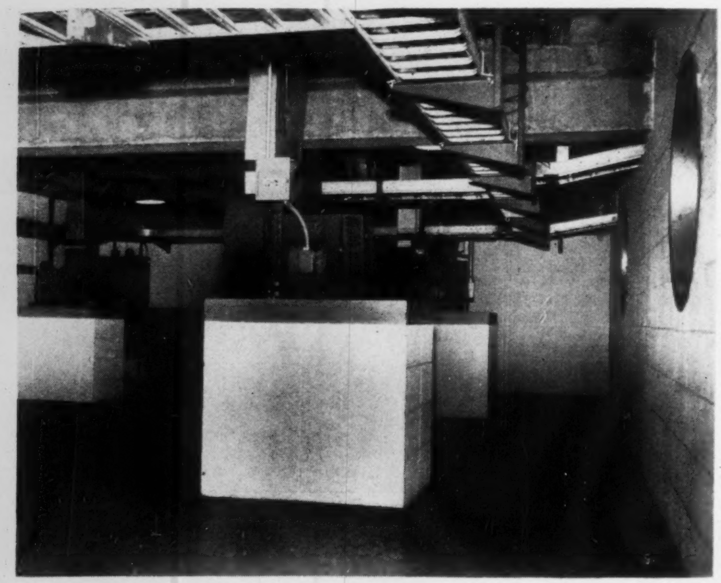
Probably any humanly conceived plan allows for some improvement. We can, from our experience with this project, suggest one or two ideas that would have been useful additions.

Reception areas with heavy traffic to and from the outside should be specially treated, particularly on the heating cycle. In this case, a booster electric duct heater was later installed in the supply air duct serving the entrance area, with a separate room thermostat for control.

In those areas which contain administrative offices, or within the "creative" spaces for editorial, directoral, or similar use, individual room temperature control is recommended. This was not provided at WWL-TV, due to initial cost considerations.

Nevertheless, the operational experience has been most satisfactory with the compromise multi-zone system which serves the studio areas.

Those who met the interesting challenge of unusual requirements and a stringent time schedule included architects Diboll-Kessels & Associates, and mechanical contractors Emile M. Babst Co. ∓



PLENUM SPACE below transmitter building provides air through centrifugal fans to ventilate transmitting equipment on floor above

the law
and your profits

JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

Is A Seller Who Sub-contracts Installation Liable for Defective Work?

CAN ONE who sells heating equipment be held liable for a defective installation performed by another? A heating plant may be purchased from a firm which in turn may subcontract the installation. The seller may find himself being sued for the faulty installation of the sub-contractor, and of course the question of what warranties the seller made to the purchaser becomes important.

There was some question as to what the warranties were in the following case.

The Garr and Tore Co. sold a furnace to the Burnum Brothers for their dry goods store. A sales contract was signed by the parties. The contract consisted of a printed form, with data necessary to cover the details of the transaction typed in prior to signing.

Above the signatures was typed "install in workmanlike manner." On the back of the contract other provisions indicating that Garr and Tore warranted the furnace to be free from defects in material and to give satisfactory service when properly installed, but that the seller did not assume responsibility for defective installation, were printed.

The price of the furnace, however, included installation. After the contract was signed, Garr and Tore without the knowledge of Burnum Brothers procured the services of a Mr. I. Wyer to install the unit.

It was necessary for Wyer to extend a wire from the burner to a thermostat, and from the thermostat to an electric service line.

A few weeks after the installation, the Burnum store was partially consumed by fire. The Burnums sued Garr and Tore, contending that overheating of the furnace caused the fire.

In the trial court, no evidence was offered that there was anything wrong with the furnace itself, but the Burnums offered some testimony and evidence that the thermostat did not operate to shut the furnace off, and that Wyer's installation was faulty.

There was a great deal of conflicting testimony as to whether a faulty installation could have caused the fire, and other conflict of fact. The jury, however, finally rendered a verdict against Garr and Tore and a judgment for damages was entered. Garr and Tore appealed the case.

One of the points that Garr and Tore argued on appeal was that the printed portion of the contract stated that there was no responsibility on their part for defective installation.

Furthermore, they argued, the installer was an agent of Burnum Brothers. The mere fact that they procured his independent services for the benefit of Burnum did not make Garr and Tore responsible for his work.

The higher court did not agree with this argument. "The typed portion of the contract," said the court, "states 'install in a workmanlike manner.' The typed portion prevails over the printed portion in determining the construction of the contract. The defendants prepared the contract, and in case of ambiguity, it should be construed in favor of the plaintiffs.

"The testimony fully supports this construction that the defendants agreed to install the furnace. The installer was hired and paid by the defendants. They agreed to install the furnace, and any faulty or defective workmanship would come within the warranty of the agreement."

Fortunately for Garr and Tore, the higher court found other fault with the decision of the lower court and sent the case back for re-trial.

But the question of whether or not the warranty extended to the installation had been settled. It did. ⌗

Unusual Air Curtain Doors Serve Garage

By C. F. MOWREY
Project Engineer
General Electric Co.
Flight Propulsion Div.

BUILDING 800 at the General Electric Co. plant in Evendale, Ohio, includes a large basement garage with entrance and exit onto a below-grade ramp. The various types of doors available for use at the 12 × 13 ft access openings were analyzed to determine which would be most suitable for the operations involved.

Several types could have been used; however an analysis of existing conditions disclosed that, considering the purposes for which the doors would be used, and the facilities available, an air curtain door of relatively simple design would best meet the requirements.

Need Safe, Fast Access

The chief factors for consideration included safety in operation, dependability in allowing safe exit in case of emergency, speed for general use, and of course the economic factors of installation and service costs.

The air curtain entrance was particularly adaptable to our needs for several reasons:

1) due to the ramp approach to the entrance, high winds would have no adverse effect on the air curtain operation,

2) maximum safety would be provided, since the doors would never be closed,

3) maximum ease and speed would be provided during times of general use for normal traffic flow,

4) because of the vehicular traffic in the garage, the minimum exhaust requirements were high enough so that no air would have to be returned through the air curtain system, and since the system would merely exhaust inside air, no heating, cooling, or filtering provisions would have to be included,

5) the nature of the space served, a garage, meant that the air velocity would not be dictated by the need to keep the breezes gentle, and for the same reason acoustical design requirements would be quite liberal, and

6) because of the manufacturing operations on the upper level, the stack effect on the garage, and the need to exhaust fume-laden air from the garage, enough make-up air was already being introduced to the building to accommodate this means of exhaust.

System Design

The entrance and exit openings form a pair, separated by a relatively short expanse of outside wall. This made it possible to "compact" the installation, for considerable space saving.

Each opening is served by a pair of vaneaxial fans, 36 in. in diameter. Short flexible ducts convey the air to vertical directional vanes located on one side of each door.

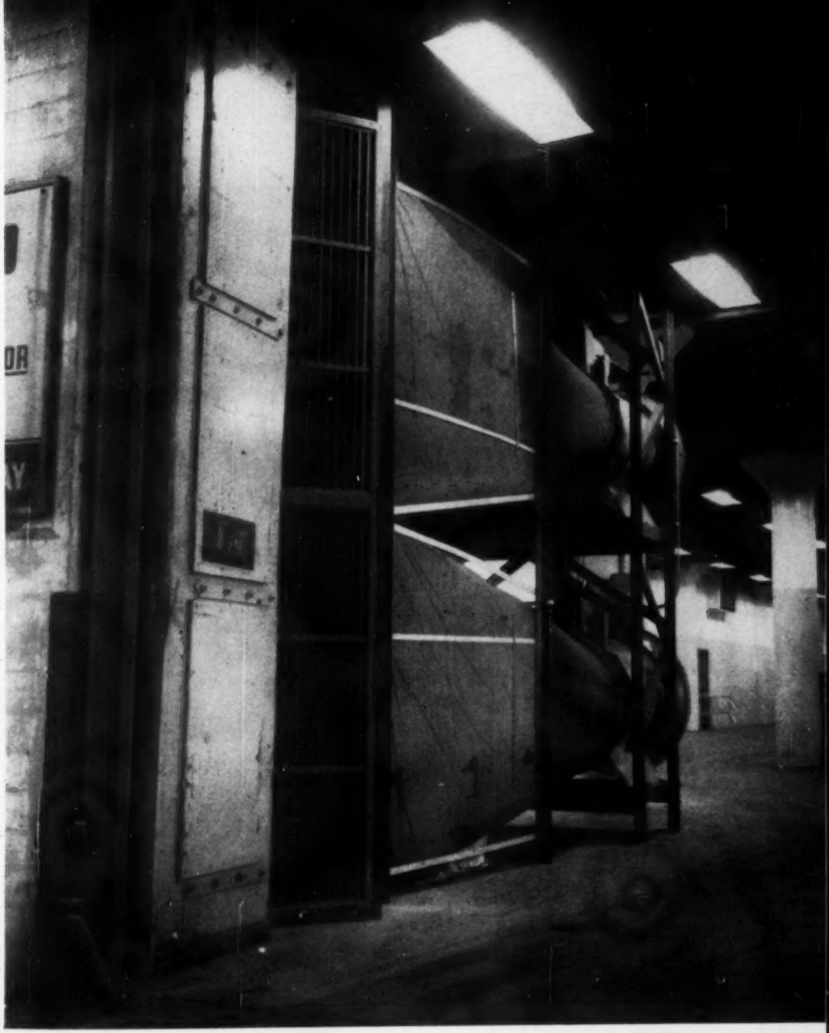
Total air flow at each door is 14,000 cfm at a velocity of 2200 fpm as it leaves the vanes. The air stream is directed at an angle of 30 degrees across the opening, to strike a short wall extension beyond the building proper.

Duct material is a coated glass fiber which is both non-porous and fireproof. Zippers are included in the ducts to provide access if necessary.

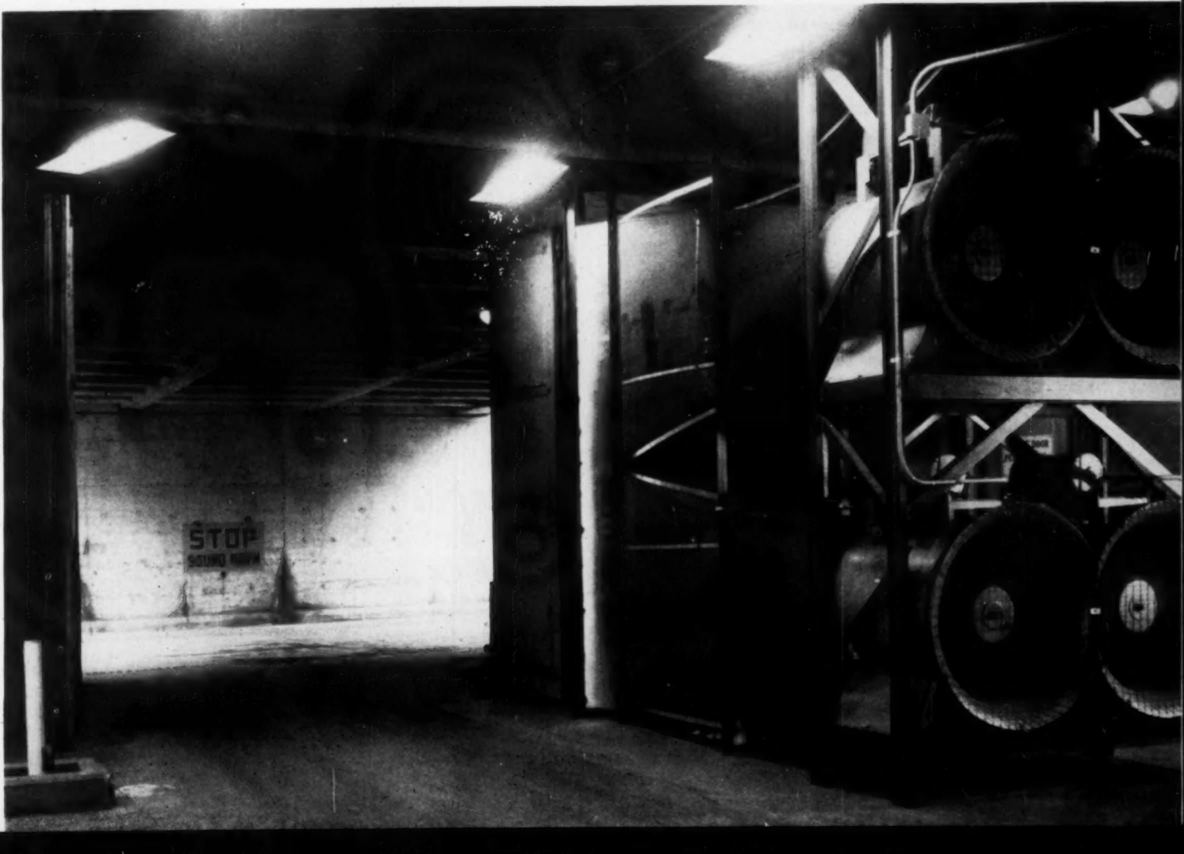
Retain Old Units

Two overhead unit heaters, each of 400,000 Btu capacity, and the permanent doors have been left in place so that during extreme conditions tempered air can be supplied if needed. The doors will serve to close the garage entirely when maintenance on the air curtain system is needed. Heavy screens are installed across the fan inlets and around the flexible ducts for safety and protection against damage.

The operation of the air curtain entrance has been quite satisfactory, even during particularly cold weather. Vehicles need no longer wait for doors to be opened before entering or leaving, and the area immediately adjacent to the doors is warmer. ‡



▶ LOOKING IN at entrance to underground garage, position of vertical vanes which direct exhaust air at angle of 30 deg across opening is apparent. 44,000 cfm of air at velocity of 2200 fpm is exhausted through grilles shown here



▼ LOOKING OUT the same opening, other half of installation can be seen. Second vertical pair of vaneaxial fans serves exit door immediately to right. Air is directed left and right to strike short wall extensions on either side

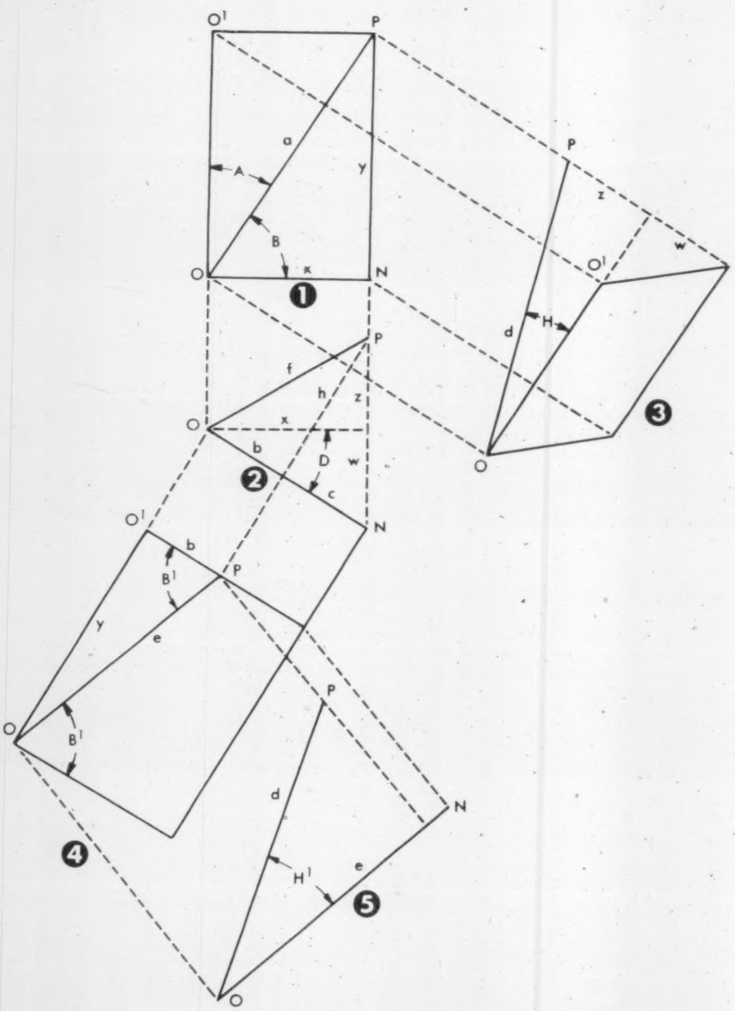
Direct reading tables (Part 2) will let you

Calculate Solar Irradiation Rate For Forward-Inclined Walls

THIS is the second in a series of three articles covering clear-day solar irradiation of walls that are inclined forward (that is, *outward*) from the base.[1] The tables apply to walls that are either east or west facing.

The method for using the tables is as described in the first article of this series; the same method is applicable to the tables presented here, as well as to those in a third article to follow. Additional examples will be presented with the third article, but here we shall concern ourselves with the development of the equations which are needed for calculating the angle

Text continues page 140



1 ANGLE OF INCIDENCE of sun's rays on forward sloping wall is determined trigonometrically as explained in text

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[1] The first of three articles in this concluding series was presented in April, 1961 — *Direct Reading Tables Let You Calculate Solar Irradiation Rate for Forward Inclined Walls*, p. 150, and covered walls facing south. The third article will deal with surfaces facing southeast or southwest.

Irradiation of *vertical* walls was covered in two previous series: for the months October through April in the July, 1949, December 1950, and May 1951 issues of HPAC; and for the months May through September in the issues of September, October, and November 1954.

Irradiation of *backward* inclined surfaces was covered in a series which appeared in August, September, and October 1955.

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and
M. O. COTTER
Engineering Consultant

TABLE 1 — MAXIMUM HOURS OF POSSIBLE IRRADIATION for vertical walls, given below, may be modified for use in calculating for inclined walls by reference to the incidence angles given in accompanying Tables 5c, 6c, 7c, and 8c

East or west facing	Latitude, degrees			
	30	35	40	45
December	5.0	4.9	4.6	4.6
January	5.3	5.0	4.8	4.7
February	5.7	5.6	5.4	5.4
March	6.0	6.0	6.0	6.0
April	6.5	6.5	6.7	6.9
May	6.8	6.9	6.9	6.9
June	7.2	7.2	7.2	7.2
July	7.2	7.2	7.2	7.2
August	6.9	6.9	6.9	6.9
September	6.4	6.4	6.4	6.4
October	5.7	5.6	5.4	5.4
November	5.3	5.0	4.8	4.7

East or West Wall — TABLE 5c — Latitude 30°

		15° Slope forward			30° Slope forward			Horizontal		
Solar Time	I_0	i	cos i	I_0 cos i	i	cos i	I_0 cos i	i	cos i	I_0 cos i
December										
8am - 4pm	194.0	43	0.7275	141.1	53	0.6007	116.5	79	0.191	37.0
9am - 3pm	265.0	58	0.5338	141.5	68	0.3822	101.3	69	0.358	95.0
10am - 2pm	286.0	71	0.3223	92.2	81	0.1589	45.4	61	0.485	138.5
11am - 1pm	296.0	85	0.0829	24.5	*	*	*	55	0.574	169.7
12 noon	298.7	*	*	*	*	*	*	53	0.602	179.7
Jan. or Nov.										
7am - 5pm	80.0	29	0.8744	70.0	40	0.7696	61.6	87	0.052	4.2
8am - 4pm	218.0	43	0.7314	159.4	53	0.5951	129.7	77	0.225	49.1
9am - 3pm	277.0	57	0.5402	149.6	68	0.3751	103.9	66	0.407	112.7
10am - 2pm	294.0	72	0.3090	90.8	82	0.1349	39.7	58	0.530	155.8
11am - 1pm	304.0	86	0.0759	23.1	*	*	*	52	0.616	187.2
12 noon	308.0	*	*	*	*	*	*	50	0.643	198.0
Feb. or Oct.										
7am - 5pm	232.0	28	0.8790	203.9	41	0.7503	174.1	82	0.139	32.2
8am - 4pm	251.0	42	0.7388	185.4	55	0.5792	145.4	72	0.309	77.6
9am - 3pm	286.0	57	0.5494	157.1	69	0.3624	103.6	61	0.485	138.7
10am - 2pm	301.0	72	0.3097	93.2	84	0.1087	32.7	51	0.629	189.3
11am - 1pm	308.0	86	0.0653	20.1	*	*	*	44	0.719	221.3
12 noon	313.5	*	*	*	*	*	*	40	0.766	240.2
Mar. or Sept.										
7am - 5pm	157.0	30	0.8675	136.2	44	0.7133	112.0	76	0.242	38.0
8am - 4pm	223.0	44	0.7252	161.7	58	0.5328	118.8	64	0.438	97.8
9am - 3pm	258.9	57	0.5377	139.2	71	0.3206	83.0	53	0.602	155.6
10am - 2pm	274.6	73	0.2902	79.7	87	0.0579	15.9	41	0.755	207.2
11am - 1pm	283.3	89	0.0208	5.9	*	*	*	32	0.848	239.4
12 noon	286.5	*	*	*	*	*	*	29	0.875	250.8
Apr. or Aug.										
6am - 6pm	69.0	25	0.9094	62.7	38	0.7830	54.0	83	0.122	8.4
7am - 5pm	202.8	36	0.8094	164.1	51	0.6283	127.4	69	0.358	72.8
8am - 4pm	241.0	47	0.6773	163.2	62	0.4651	112.1	58	0.530	127.7
9am - 3pm	270.4	62	0.4623	125.0	77	0.2214	59.9	44	0.719	194.5
10am - 2pm	282.5	76	0.2476	69.9	*	*	*	33	0.839	237.0
11am - 1pm	289.4	*	*	*	*	*	*	22	0.927	268.3
12 noon	290.0	*	*	*	*	*	*	18	0.951	276.0
May or July										
6am - 6pm	107.5	30	0.8647	93.0	43	0.7286	78.3	80	0.174	18.7
7am - 5pm	207.2	38	0.7826	162.2	53	0.6007	124.5	68	0.375	77.7
8am - 4pm	252.2	51	0.6277	158.3	66	0.4048	102.1	54	0.588	148.0
9am - 3pm	273.4	63	0.4531	123.9	78	0.2071	56.6	42	0.743	203.0
10am - 2pm	285.5	77	0.2301	65.7	*	*	*	29	0.875	249.7
11am - 1pm	291.3	*	*	*	*	*	*	17	0.956	278.4
12 noon	293.0	*	*	*	*	*	*	10	0.985	288.5
June										
6am - 6pm	149.9	34	0.8268	123.9	47	0.6804	102.0	77	0.225	33.8
7am - 5pm	237.9	47	0.6797	161.7	62	0.4712	112.1	59	0.515	122.6
8am - 4pm	254.6	53	0.6082	154.8	67	0.3838	97.7	53	0.602	153.1
9am - 3pm	276.9	66	0.4072	112.8	81	0.1561	43.2	39	0.777	215.2
10am - 2pm	286.7	78	0.2045	58.6	*	*	*	27	0.891	255.2
11am - 1pm	292.2	*	*	*	*	*	*	14	0.970	283.5
12 noon	293.1	*	*	*	*	*	*	6	0.995	291.5

*At these times the solar altitude is too high to permit irradiation of the wall.

of incidence of the sun's rays on a forward-inclined wall. These are the equations from which the i values in columns 3 and 6 of the tables have been calculated.

Development Is Trigonometric

Determination of the angle of the sun's incidence on a forward-sloping wall is a trigonometric problem involving geometric relationships between the plane of the wall and the direction of the sun's rays.

In Fig. 1 (1), let OO^1 represent the base line of a wall running in a north-south direction, and facing east. From point O of Fig. 1(1), the line ON indicates a horizontal projection of a line from point O extending in the direction of the sun's position at any selected time and day.

Let the distance x be arbitrarily defined as unity.

The angle A is the sun's azimuth, defined as the number of degrees that the sun is clockwise from due north, during the morning hours, or counter-clockwise from due north in the afternoon.

For this east-facing wall, angle B, the horizontal projection of the angle between a normal to the wall and the direction of the sun's rays, is equal to $90 - A$. Then,

$$x = 1$$
$$y = \tan B$$

Fig. 1(2) is an elevation looking north, showing that the wall is inclined forward by the amount of the angle D, since the normal to the wall, ON, is D degrees below the horizontal.

The distance z is obtained from Fig. 1(3), which is an elevation

East or West Wall | TABLE 6c | Latitude 35°

		15° Slope forward			30° Slope forward			Horizontal		
Solar Time	I_0	i	cos i	I_0 cos i	i	cos i	I_0 cos i	i	cos i	I_0 cos i
December										
8am - 4pm	179.0	44	0.7250	129.8	53	0.6031	108.0	80	0.174	31.1
9am - 3pm	239.0	56	0.5544	132.5	65	0.4186	100.0	73	0.292	69.9
10am - 2pm	267.0	70	0.3493	93.3	78	0.2040	54.5	66	0.407	108.6
11am - 1pm	279.0	84	0.1075	30.0	*	*	*	61	0.485	135.2
12 noon	287.6	*	*	*	*	*	*	58	0.530	152.4
Jan. or Nov.										
8am - 4pm	196.0	43	0.7369	144.4	52	0.6093	119.4	79	0.191	37.4
9am - 3pm	268.0	57	0.5450	146.1	67	0.3924	105.2	69	0.358	96.1
10am - 2pm	287.0	71	0.3306	94.9	80	0.1704	48.9	62	0.470	134.8
11am - 1pm	294.0	84	0.1024	30.1	*	*	*	58	0.530	155.9
12 noon	300.0	*	*	*	*	*	*	55	0.574	172.0
Feb. or Oct.										
8am - 4pm	245.0	42	0.7403	181.4	54	0.5851	143.3	73	0.292	71.7
9am - 3pm	282.0	56	0.5609	158.2	68	0.3810	107.4	63	0.454	128.0
10am - 2pm	297.0	71	0.3184	94.6	83	0.1277	37.9	54	0.588	174.5
11am -1pm	303.0	85	0.0796	24.1	*	*	*	49	0.656	198.8
12 noon	308.9	*	*	*	*	*	*	45	0.707	218.2
Mar. or Sept.										
7am - 5pm	157.0	30	0.8657	135.9	45	0.7112	111.7	76	0.242	38.0
8am - 4pm	223.0	45	0.7122	158.8	59	0.5208	116.1	64	0.438	97.8
9am - 3pm	258.9	58	0.5370	139.0	71	0.3274	84.8	55	0.574	148.4
10am - 2pm	273.4	74	0.2727	74.6	87	0.0452	12.4	42	0.743	203.2
11am - 1pm	280.8	89	0.0222	6.2	*	*	*	35	0.819	230.0
12 noon	283.5	*	*	*	*	*	*	32	0.848	240.3
Apr. or Aug.										
6am - 6pm	83.5	25	0.9066	75.7	39	0.7744	64.7	82	0.139	11.6
7am - 5pm	189.8	56	0.5592	106.1	41	0.7547	143.2	71	0.326	61.8
8am - 4pm	241.0	48	0.6738	162.4	62	0.4624	111.4	58	0.530	127.7
9am - 3pm	267.7	61	0.4810	128.8	76	0.2451	65.6	46	0.695	186.1
10am - 2pm	281.6	76	0.2435	68.6	*	*	*	34	0.829	233.4
11am - 1pm	287.2	*	*	*	*	*	*	26	0.899	258.0
12 noon	289.1	*	*	*	*	*	*	22	0.927	268.0
May or July										
6am - 6pm	133.5	32	0.8494	113.4	45	0.7059	94.2	78	0.208	27.8
7am - 5pm	211.6	39	0.7771	164.4	54	0.5913	125.1	67	0.391	82.7
8am - 4pm	252.2	51	0.6309	159.1	66	0.4078	102.8	54	0.588	148.2
9am - 3pm	274.6	64	0.4306	118.2	79	0.1836	50.4	41	0.755	207.4
10am - 2pm	284.8	77	0.2238	63.7	*	*	*	30	0.866	246.7
11am - 1pm	290.2	*	*	*	*	*	*	20	0.940	272.5
12 noon	291.8	*	*	*	*	*	*	15	0.966	281.6
June										
6am - 6pm	157.0	35	0.8237	129.3	48	0.6734	105.7	76	0.242	38.0
7am - 5pm	223.0	43	0.7357	164.1	57	0.5418	120.8	64	0.438	97.8
8am - 4pm	256.7	53	0.5995	153.9	68	0.3725	95.6	52	0.616	158.0
9am - 3pm	276.9	66	0.4051	112.2	81	0.1544	42.8	39	0.777	215.0
10am - 2pm	286.7	79	0.1888	54.1	*	*	*	27	0.891	255.4
11am - 1pm	291.3	*	*	*	*	*	*	17	0.956	278.5
12 noon	292.5	*	*	*	*	*	*	12	0.978	286.0

***At these times the solar altitude is too high to permit irradiation of the wall.**

taken normal to the *OP* horizontal projection of Fig. 1(1).

Angle *H* of Fig. 1(3) is the known value of the solar altitude at the time in question. Fig. 1(4) is a plan view, taken in a direction normal to *ON* of Fig. 1(3). Fig. 1(5) is an elevation taken normal to *OP* of Fig. 1(4).

From Fig. 1(1):

$$\begin{aligned} a &= (x^2 + y^2)^{1/2} \\ &= (1 \tan^2 B)^{1/2} \end{aligned}$$

From Fig. 1(3):

$$\begin{aligned} z &= a \tan H \\ &= (1 \tan^2 B)^{1/2} \tan H \end{aligned}$$

and

$$\begin{aligned} d &= (a^2 + z^2)^{1/2} \\ &= (1 + \tan^2 B + \tan^2 H + \tan^2 B \tan^2 H)^{1/2} \end{aligned}$$

From Fig. 1(2)

$$b = [f^2 + (b + c)^2 - (z + w)^2]/2(b + c)$$

but

$$\begin{aligned} f &= (x^2 + z^2)^{1/2} \\ &= (1 + \tan^2 H + \tan^2 B \tan^2 H)^{1/2} \end{aligned}$$

and

$$w = \tan D$$

and

$$\begin{aligned} (b+c)^2 &= x^2 + w^2 \\ &= 1 + \tan^2 D \end{aligned}$$

Substituting in the equation for *b*,

$$b = \{(1 + \tan^2 H + \tan^2 B \tan^2 H) + (1 + \tan^2 D) - [\tan^2 H + \tan^2 B \tan^2 H + 2 \tan D (1 + \tan^2 B)^{1/2} \tan H + \tan^2 D]\} /2 (1 + \tan^2 D)^{1/2}$$

which simplifies to

$$b = [1 - (1 + \tan^2 B)^{1/2} \tan H \tan D]/(1 + \tan^2 D)^{1/2}$$

From Fig. 1(4)

$$\begin{aligned} \tan B^1 &= y/b \\ &= [\tan B (1 + \tan^2 D)^{1/2}]/[1 - (1 + \tan^2 B)^{1/2} \tan H \tan D] \qquad (I) \end{aligned}$$

where B^1 for the forward-inclined wall is comparable to *B* for a vertical wall.

East or West Wall **TABLE 7c** **Latitude 40°**

		15° Slope forward			30° Slope forward			Horizontal		
Solar Time	**I_o**	**i**	**cos i**	**I_o cos i**	**i**	**cos i**	**I_o cos i**	**i**	**cos i**	**I_o cos i**
December										
8am - 4pm	168.0	43	0.7315	122.9	52	0.6135	103.1	81	0.156	26.3
9am - 3pm	223.0	56	0.5647	125.9	64	0.4414	98.4	76	0.242	54.0
10am - 2pm	261.0	69	0.3517	91.8	77	0.2234	58.3	70	0.342	89.2
11am - 1pm	274.0	83	0.1231	33.7	*	*	*	66	0.407	111.5
12 noon	276.8	*	*	*	*	*	*	65	0.423	117.0
Jan. or Nov.										
8am - 4pm	170.0	41	0.7507	127.6	51	0.6307	107.2	81	0.156	26.6
9am - 3pm	240.0	55	0.5738	137.7	64	0.4404	105.7	74	0.276	66.2
10am - 2pm	277.0	70	0.3493	96.8	78	0.2039	56.5	66	0.407	112.7
11am - 1pm	287.0	83	0.1278	36.7	*	*	*	62	0.470	134.9
12 noon	288.0	*	*	*	*	*	*	61	0.485	139.7
Feb. or Oct.										
7am - 5pm	152.0	29	0.8739	132.8	42	0.7460	113.4	82	0.139	21.2
8am - 4pm	232.0	41	0.7572	175.7	52	0.6091	141.3	75	0.259	60.0
9am - 3pm	274.0	56	0.5608	153.7	67	0.3935	107.8	66	0.407	111.5
10am - 2pm	291.0	71	0.3328	96.8	81	0.1562	45.5	58	0.530	154.1
11am - 1pm	298.0	85	0.0826	24.6	*	*	*	53	0.602	179.5
12 noon	304.5	*	*	*	*	*	*	51	0.629	191.7
Mar. or Sept.										
7am - 5pm	133.5	28	0.8821	117.8	43	0.7345	98.1	78	0.208	27.8
8am - 4pm	215.6	44	0.7242	156.1	57	0.5401	116.4	66	0.407	87.8
9am - 3pm	247.0	58	0.5270	130.2	71	0.3224	79.6	56	0.559	138.1
10am - 2pm	264.5	72	0.3165	83.7	84	0.1043	27.6	48	0.669	177.0
11am - 1pm	274.6	87	0.0523	14.4	*	*	*	41	0.755	207.4
12 noon	277.0	*	*	*	*	*	*	39	0.777	215.2
Apr. or Aug.										
6am - 6pm	98.0	26	0.9022	88.4	40	0.7660	75.1	81	0.156	15.3
7am - 5pm	196.3	35	0.8157	160.1	50	0.6404	125.7	70	0.342	67.1
8am - 4pm	237.9	47	0.6797	161.7	62	0.4710	112.1	59	0.515	122.5
9am - 3pm	264.4	60	0.4927	130.3	75	0.2621	69.3	48	0.669	177.0
10am - 2pm	278.9	75	0.2648	73.9	*	*	*	38	0.788	220.0
11am - 1pm	284.1	89	0.0117	3.3	*	*	*	31	0.857	243.5
12 noon	286.8	*	*	*	*	*	*	27	0.891	255.7
May or July										
6am - 6pm	149.9	32	0.8466	126.9	46	0.6986	104.7	77	0.225	33.8
7am - 5pm	211.6	39	0.7815	165.4	53	0.5960	126.1	67	0.391	82.7
8am - 4pm	249.8	50	0.6427	160.5	65	0.4217	105.3	55	0.574	143.3
9am - 3pm	272.1	63	0.4501	122.5	78	0.2075	56.5	43	0.731	199.0
10am - 2pm	282.5	76	0.2431	68.7	*	*	*	33	0.839	237.0
11am - 1pm	288.3	*	*	*	*	*	*	24	0.914	263.5
12 noon	290.2	*	*	*	*	*	*	20	0.940	272.5
June										
6am - 6pm	165.2	35	0.8206	135.6	48	0.6659	110.0	75	0.259	42.8
7am - 5pm	226.5	43	0.7328	166.0	58	0.5351	121.2	63	0.454	102.8
8am - 4pm	256.7	37	0.7986	205.0	22	0.9272	238.0	52	0.616	158.0
9am - 3pm	275.8	66	0.4131	113.9	80	0.1651	45.5	40	0.766	211.2
10am - 2pm	285.5	79	0.1981	56.6	*	*	*	29	0.875	250.0
11am - 1pm	289.8	*	*	*	*	*	*	21	0.934	271.0
12 noon	290.8	*	*	*	*	*	*	16	0.961	279.3

***At these times the solar altitude is too high to permit irradiation of the wall.**

For a wall inclined 15 degrees forward (into the sun) equation (I) simplifies to

$$\tan B^1 = 1.035 \tan B/[1 - 0.2679 \tan H(1 + \tan^2 B)^{1/2}] \qquad \text{(Ia)}$$

and for a wall inclined 30 degrees forward, it becomes

$$\tan B^1 = 1.155 \tan B/[1 - 0.5774 \tan H(1 + \tan^2 B)^{1/2}] \qquad \text{(Ib)}$$

From Fig. 1(5):

$$\cos H^1 = e/d$$

but from Fig. 1(4)

$$\begin{aligned} e &= y/\sin B^1 \\ &= \tan B/\sin B^1 \end{aligned}$$

Hence:

$$\cos H^1 = (\tan B/\sin B^1)/(1 + \tan^2 B + \tan^2 H + \tan^2 B \tan^2 H)^{1/2}$$

where the angle H^1 for the forward-inclined wall is comparable to the solar altitude, H, as measured with respect to a vertical wall.

The actual angle of incidence, i, is therefore the angle whose cosine is the product of the cosines of the angles B^1 and H^1; thus

$$\cos i = \cos B^1 \cos H^1$$

The above equation was used for calculating all values of the angle of incidence that appear in the third and sixth columns of the tables for forward-inclined walls. For horizontal surfaces, the angle of incidence, as given in the ninth column of each table, did not require calculation, as it is numerically equal to the difference between 90 degrees and the actual solar altitude, H.

Cosines in the tables have been calculated to four decimal places, but corresponding angles are given only to the nearest degree.

East or West Wall **TABLE 8c** **Latitude 45°**

		15° Slope forward			30° Slope forward			Horizontal		
Solar Time	I_n	i	cos i	I_n cos i	i	cos i	I_n cos i	i	cos i	I_n cos i
December										
8am - 4pm	168.0	44	0.7216	121.2	53	0.6046	101.6	81	0.156	16.3
9am - 3pm	194.0	55	0.5728	111.1	62	0.4623	89.7	79	0.191	37.0
10am - 2pm	215.0	67	0.3837	82.5	74	0.2836	61.0	77	0.225	48.4
11am - 1pm	251.0	81	0.1579	39.6	87	0.0586	14.7	72	0.309	77.6
12 noon	260.0	*	*	*	*	*	*	69	0.358	93.3
Jan. or Nov.										
8am - 4pm	154.0	42	0.7477	115.1	51	0.6327	97.4	82	0.139	21.4
9am - 3pm	218.0	54	0.5838	127.3	62	0.4628	100.9	77	0.225	49.1
10am - 2pm	248.0	67	0.3863	95.8	74	0.2678	66.4	73	0.292	72.6
11am - 1pm	271.0	81	0.1500	40.7	88	0.0340	9.2	68	0.375	101.5
12 noon	280.0	*	*	*	*	*	*	65	0.423	118.4
Feb. or Oct.										
8am - 4pm	215.0	40	0.7652	164.5	51	0.6254	134.5	77	0.225	48.4
9am - 3pm	268.0	55	0.5688	152.4	66	0.4093	109.7	68	0.375	100.5
10am - 2pm	282.0	69	0.3639	102.6	78	0.2044	57.6	63	0.454	128.2
11am - 1pm	291.0	84	0.1024	29.8	*	*	*	58	0.530	154.2
12 noon	296.7	*	*	*	*	*	*	55	0.574	170.0
Mar. or Sept.										
7am - 5pm	117.0	28	0.8813	103.1	42	0.7392	86.5	79	0.191	22.3
8am - 4pm	207.2	42	0.7394	153.2	56	0.5623	116.5	68	0.375	77.7
9am - 3pm	237.9	56	0.5532	131.6	69	0.3577	85.1	59	0.515	122.5
10am - 2pm	258.9	71	0.3197	82.8	83	0.1178	30.5	51	0.629	162.8
11am - 1pm	267.7	87	0.0579	15.5	*	*	*	46	0.695	186.2
12 noon	270.6	*	*	*	*	*	*	44	0.719	194.8
Apr. or Aug.										
6am - 6pm	98.0	37	0.8021	78.6	47	0.6768	66.3	81	0.156	15.3
7am - 5pm	196.3	35	0.8171	160.4	50	0.6421	126.0	70	0.342	67.2
8am - 4pm	235.1	47	0.6854	161.1	61	0.4805	113.0	60	0.500	117.5
9am - 3pm	260.4	60	0.4932	128.4	74	0.2696	70.2	50	0.643	167.5
10am - 2pm	274.6	74	0.2682	73.6	88	0.0381	10.5	41	0.755	207.3
11am - 1pm	280.8	88	0.0309	8.7	*	*	*	35	0.819	230.0
12 noon	283.5	*	*	*	*	*	*	32	0.848	240.5
May or July										
6am - 6pm	157.0	32	0.8471	133.0	46	0.6946	109.1	76	0.242	38.0
7am - 5pm	219.6	40	0.7653	168.1	55	0.5721	125.6	65	0.423	92.9
8am - 4pm	249.8	50	0.6384	159.5	65	0.4187	104.6	55	0.574	143.2
9am - 3pm	269.3	62	0.4630	124.7	77	0.2253	60.7	45	0.707	190.7
10am - 2pm	280.8	76	0.2419	67.9	*	*	*	35	0.819	230.0
11am - 1pm	286.1	*	*	*	*	*	*	28	0.883	252.5
12 noon	287.8	*	*	*	*	*	*	25	0.906	261.0
June										
6am - 6pm	172.1	35	0.8168	140.6	49	0.6581	113.3	74	0.276	47.5
7am - 5pm	226.5	43	0.7369	166.9	57	0.5388	122.0	63	0.454	102.8
8am - 4pm	256.7	53	0.5995	153.9	68	0.3725	95.6	52	0.616	158.1
9am - 3pm	273.4	65	0.4291	117.3	79	0.1854	50.7	42	0.743	203.5
10am - 2pm	283.3	78	0.2147	60.8	*	*	*	32	0.848	240.3
11am - 1pm	287.8	*	*	*	*	*	*	25	0.906	261.5
12 noon	289.9	*	*	*	*	*	*	21	0.934	271.5

*At these times the solar altitude is too high to permit irradiation of the wall.

How Underground Reservoirs Provide Cool Water for Industrial Uses

The Hydraulics of Aquifers

By JOHN F. HOFFMAN
Director of Research and Development
Griffin Wellpoint Corp.

Water for industrial process and cooling applications can be obtained from either above or below the earth's surface. The latter (ground water) in some locations constitutes an almost unending supply at comparatively low and constant temperature, delivered to the pumping well almost without charge. But because ground water of sufficient quality and quantity is not available at every site, more or less extensive investigation must be made into the character of the reservoir which underlies any particular location.

This article describes some of the means of determining the kind and amount of water obtainable, through a consideration of the factors which influence storage, replenishment, water movement, and contamination. An earlier article[1] described the basic character of underground reservoirs.

MERELY INDUCING ground water into a well does not necessarily constitute success in obtaining a required ground water supply. True success connotes a sustained flow of water of satisfactory quality for a long period of time. The factors which influence the degree of success include aquifer replenishment and depletion; the composition, dimensions, and hydraulic characteristics of the aquifer; the pumping equipment used; well design and construction; and the chemical and physical qualities of the ground water itself.

What Constitutes the Reservoir?

The ground water reservoir is composed of all the consolidated and unconsolidated rock below the water table. The term "rock," as used here, applies to both unconsolidated rock, such as silt and sand, and to consolidated rock, as used in the popular sense.

The ground water reservoir is divided into aquifers and aquicludes. The aquifers are distinguished from aquicludes on the basis that under comparable conditions, aquifers yield and transmit greater quantities of water than do aquicludes. That is, an aquifer is a water-bearing body that yields and transmits its water readily; an aquiclude a body that does not. The line of demarcation is not distinct, but in gen-

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[1] *How Underground Reservoirs Provide Cool Water for Industrial Uses*, Heating, Piping & Air Conditioning, October, 1960

GROUND WATER FOR INDUSTRY

eral, properly constructed *wells* terminating in aquifers yield water readily, and wells terminating in aquicludes do not.

Investigation Shows Nature

The ability of an aquifer to yield and transmit a desired quantity of water of a specified quality must be determined by investigation. The extent and detail of the survey will be determined by the quantity and quality of water that is sought, the money available, known ground water problems in the area, the size of the plant which will use the water, and the possibility of future expansion.

A water supply of 100 gal per minute in a region of abundant replenishment where the aquifer is 200 ft thick, laterally extensive, relatively undeveloped and largely composed of sand may require a single well more or less casually placed. Obtaining 5000 gpm for industrial purposes where the only available aquifer is of sandstone, laterally extensive, 50 ft thick and hydraulically connected to a polluted river will obviously pose more difficulties. In the latter case, considerable evaluation will be necessary.

What to Consider

When seeking a ground water supply, a knowledge of the factors affecting water storage and movement within the ground water reservoir is necessary. The first consideration involves the thickness, extent, and composition of the reservoir in the region of development. Samples obtained from well drilling or test borings and a general review of the geology of the area will indicate the nature of the reservoir.

Other important factors affecting the storage and movement of ground water include

1) rate of aquifer replenishment
2) rate of aquifer depletion
3) proximity of "sinks" to the well installation
4) chemical and physical qualities of the water in the reservoir
5) storage coefficient of the aquifer in the region of development, and
6) permeability of the aquifer in the region of development.

Aquifer replenishment underlying a site was discussed at length in the first article of this series. Briefly, it depends upon precipitation, recharge by surface water bodies or by wells and basins, and ground water flow into the area. The rate of depletion depends upon evaporation, discharge to surface water bodies or to man-made collecting devices, and ground water flow out of the area.

Once having entered the ground water reservoir, the direction of movement of the replenishing water through the aquifer is controlled by "sinks." These might be surface bodies of water, such as oceans, rivers, marshy areas, or areas of mass ground water withdrawals; at any one location, sinks might be depressions in the water table (or piezometric surface) created by collecting devices, such as wells.

For small ground water supply, the role of sinks may be inconspicuous. Where subsurface disposal of waste water is practiced, however, the role of sinks might be very evident. For instance, the attraction of cooling or process water returned upgradient to the well being pumped might create a serious temperature or contamination problem.

Water Quality Is Most Important

As water is only suitable if it can be used for the purpose intended, the importance of the physical and chemical qualities of ground water cannot be overemphasized. Water quality not only influences usage, but can play an important part in the economical operation of the well and pumping equipment.

Water *quantity* is equally important. No simple determination of the amount of water available is possible, because of the number of variables involved. The principle variable involves the hydraulic characteristics of the aquifer, including storage coefficient and permeability. A third term, transmissibility, is a factor obtained by multiplying the permeability of the aquifer by its saturated thickness.

What Information Is Needed?

Planning any large scale ground water development requires a detailed knowledge of the hydraulic

In considering the use of ground water, know what factors affect water storage and water movement within the reservoir.

characteristics of both the aquifer and the wells that tap the aquifer. With this information in hand, together with the other factors mentioned, the following information for a well system can be supplied:

1) effects on the water table or piezometric surface of pumping one well or a group of wells

2) possibility of temperature, bacterial, or chemical contamination of the ground water supply from nearby water bodies by withdrawing ground water from the aquifer

3) spacing of wells used for recharging spent cooling or process water, in relation to the supply well location

4) maximum capacity of an installed well, and

5) pump selection and positioning of the pump intake.

The basic expression that interrelates the velocity of flow of water through an aquifer, the permeability of the aquifer, and the hydraulic gradient is Darcy's law, which may be expressed as

$$Q = PIA$$

where

Q = rate of flow, gal per day
P = coefficient of permeability of aquifer in the direction of flow, gal per day per sq ft, under hydraulic gradient of 1 ft decline in head for each ft along the gradient, at 60 F
I = hydraulic gradient, feet per foot
A = area of aquifer through which flow is taking place, sq ft

Darcy's law is applicable only when flow is in the laminar region. As in the case of pipe flow, the criterion for determining whether flow is in the laminar or turbulent regions is the Reynold's number.

Applied to the movement of water within an aquifer, the Reynold's number (R) may be written as follows:

$$R = vd/\nu$$

where

v = velocity of flow, ft per second
d = mean grain diameter, ft
ν = kinematic viscosity, sq ft per second

Below a Reynold's number of one, ground water flow is considered as being laminar. Departure from laminar flow begins when the flow has a Reynold's number of about one to ten, depending upon the predominant grain size and shape. Fully established turbulence may not be reached until a Reynold's number of 1000.

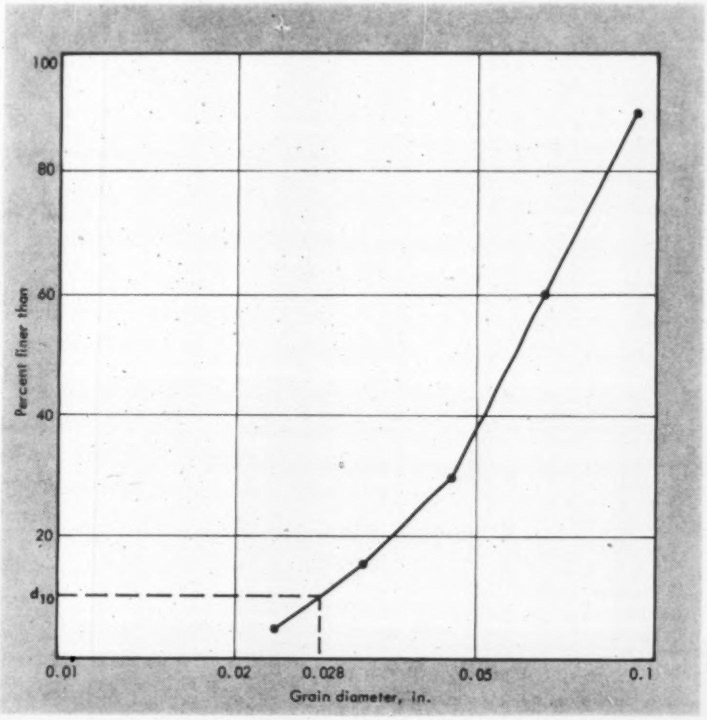
Examples Show Determination

Considering the portion of an aquifer away from pumped wells, where the temperature of the ground water is 50 F (kinematic viscosity: $\nu = 1.41 \times 10^{-5}$ sq ft per sec), the velocity of flow is 0.8 ft per day, and the mean grain diameter is 0.10 in. (coarse sand), the Reynold's number is as follows:

$$R = (0.8/86{,}400)\ (0.1/12)/(1.41)\ (10^{-5}) = 0.006$$

indicating laminar flow.

On the other hand, considering the flow at a point 3 ft from the centerline of a well being pumped at



1 GRAIN SIZE analysis in laboratory includes process in which dried and weighed sample of soil is screened through several sieves, and the weight retained on each sieve is determined. Mesh size of each sieve varies. Result is curve at right; a plot of "percent passing *vs* grain size"

GROUND WATER FOR INDUSTRY

1500 gpm (10 cfs), that fully penetrates an artesian aquifer 30 ft thick with a mean grain diameter of 0.10 in., a porosity of 1/3 and containing water at 50 F, the Reynolds number is determined as:

$$R = (5.3)(10^{-2})(0.1/12)/(1.41)(10^{-5}) = 31.5$$

indicating turbulent flow.

It is evident from this that away from the close proximity of collecting devices, such as wells or streams, the flow of ground water usually occurs in the laminar region, and Darcy's law is applicable.

How Permeability Is Determined

There are various ways of determining the coefficient of permeability of an aquifer. These methods, divided into those of the laboratory and those conducted in the field, are as follows:

Laboratory methods

1) grain size analysis

2) laboratory permeameters, falling head or constant head types.

Field methods

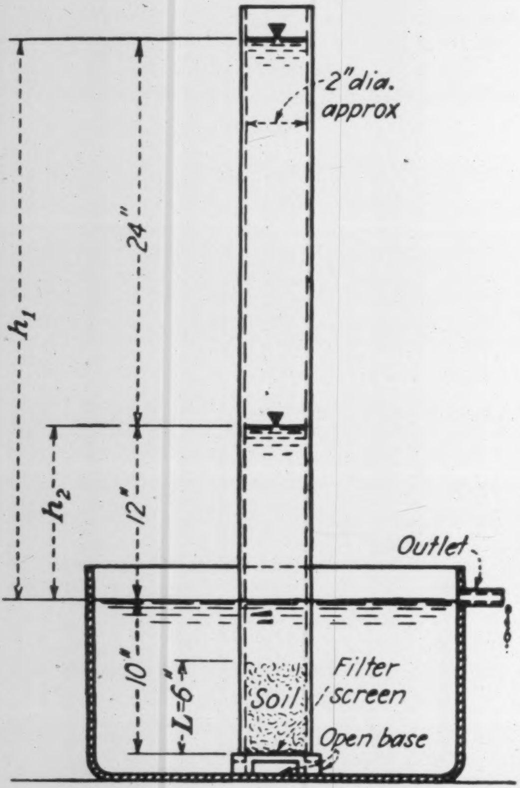
1) tracers — including dyes, chemical compounds, radioactive materials, and electrolytes

2) field permeameters

3) aquifer performance tests (pumping tests)

4) regional analysis

We shall discuss each of these methods in turn.



2 FALLING HEAD PERMEAMETER for laboratory use in determining aquifer permeability

Grain Size Analysis

Grain size has been related to the permeability of aquifers composed of unconsolidated materials by a number of investigators. The formula devised by Hazen is the most frequently encountered. This formula, based on the representative grain size of the sample, is expressed as

$$P = Cd_{10}^2 \ (10 + t)/60$$

where

P = permeability, gal per day per sq ft

C = coefficient determined empirically by Hazen and ranges from 7×10^6 for very closely packed sand containing a considerable quantity of alumina and iron, to 19×10^6 for very uniform and perfectly clean sand

d_{10} = diameter of a particle such that 10 percent of the sample is finer than the d_{10} diameter, in.

t = temperature of the aquifer water, F

The d_{10} grain size of a soil sample is relatively simple to determine. A dried and weighed sample of soil is screened through a series of sieves, and the weight retained on each sieve determined. From this value, the percent by weight of the sample passing *through* each sieve is computed. The percent passing *vs* the opening size is plotted on semi-logarithmic paper.

Plot Mesh Size & Percent Passing

The opening of the mesh, which represents grain size, is plotted on the logarithmic scale, and the percent passing is plotted on the arithmetic scale. The curve is then entered at "10 percent passing" to obtain the corresponding grain diameter and substitution made in the formula above.

For example, the total weight of the dried sample of sand is 100 grams. The weight retained on each sieve is shown in Table 1.

The curve of "percent passing *vs* grain size" is shown in Fig. 1. Selecting the d_{10} size as 0.028 in., the permeability where the ground water temperature is 50 F is computed as follows:

$$P = [10 \times 10^6]\ [0.028^2]\ [(10 + 50)/60]$$
$$= 7840 \text{ gal per day per sq ft}$$

Methods for determining permeability based upon the grain size analysis have a number of drawbacks. As only a very small part of an aquifer is sampled, a large number of samples must be analyzed before a representative value of permeability can be determined.

Inasmuch as the soil sample is completely disturbed, the natural compaction and cementation, which markedly influence permeability, is not taken into account. This also applies to the shape, distribution, and orientation of the grains composing the aquifer. Despite these drawbacks, in the absence of other information, grain size analysis enables at least a rough appraisal of aquifer permeability.

Laboratory Permeameters

The second laboratory method of determining permeability is adaptable to either unconsolidated or consolidated rock. Darcy's law ($Q=PIA$) provides the basis for this determination.

There are two types of apparatus in use — falling head permeameters and constant head permeameters. Some available apparatus can be used with either approach.

Samples of unconsolidated material are collected from test holes by means of special soil sampling devices equipped with liners that can be fitted directly to a permeameter. Where unconsolidated material is collected through other means, it is repacked in the barrel of the permeameter.

Consolidated rock samples are cored from bedrock by means of special bits. The core is then fixed in the barrel of the permeameter by means of paraffin.

The falling head permeameter is shown schematically in Fig. 2. The formula for computing permeability in gal per day per sq ft, using this apparatus, is

$$P = (17.3L/t)\ (\log_{10} h_1/h_2)$$

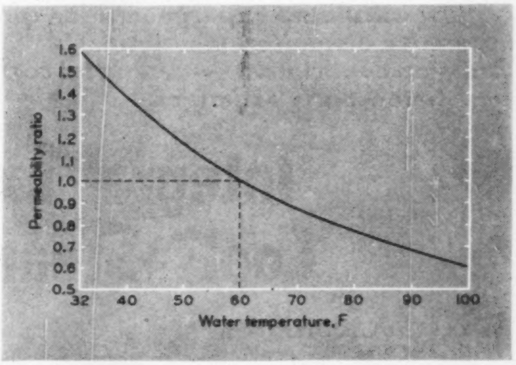
where

L = length of sample, ft

t = time for water level to fall from h_1 to h_2, days

h_1 & h_2 = height above water level at time t_1 and t_2, respectively, ft

Convenient dimensions are included for these factors in Fig. 2.



3 VARIATION in ratio of permeability of aquifer containing water at 60 F to permeability of same aquifer with water at any temperature is shown by curve above

In the constant head method, the average rate of discharge through a sample of length L, and cross sectional area A under a constant head is measured. To compute permeability with this method:

$$P = VL/thA$$

where

V = total volume of water which flowed in elapsed time t, gal

h = head lost, ft

L = length of soil sample in permeameter, ft

A = cross sectional area of permeameter, sq ft

t = elapsed time, days.

The units in these formulas are not indicative of the size of the apparatus, nor the time length of the test, but are required to make each formula dimensionally consistent.

The permeability of the sample is at the temperature of the water used for the test. Where it is desired to convert this permeability to standard conditions at 60 F, the curve shown in Fig. 3 should be used. Owing to the ionic interchange between the water and some soils, wherever possible water that occurs naturally in the aquifer being investigated should be used. Entrapment of air in laboratory permeameters can also cause variation in the permeability determined. Elimination of this problem can be effected by using de-aired water and care in filling the apparatus. ⧧

TABLE 1 — COMPILATION of data obtained by passing 100 grams of dried sand through series of sieves with variable size mesh openings

Sieve No.*	Opening, in.	Weight retained, grams	Cumulative weight retained, grams	Weight passing, grams	Percent passing
6	0.131	0	—	—	—
8	0.093	10	10	90	90
10	0.065	30	40	60	60
14	0.046	30	70	30	30
20	0.0328	15	85	15	15
28	0.0232	10	95	5	5

*Sieve number can vary with manufacturer's method of designation, is correlated with mesh opening size

The next article in this series will discuss the field methods of determining the coefficient of permeability of an aquifer. Succeeding articles will cover such topics as wells and well drilling, pumps and pumping equipment, the chemistry of ground water and corrosion, and ground water problems.

• How calculated experimentation cured excessive discomfort in a clothier's pressing department — for a total cost well below early estimates.

Integral Exhaust Hoods "Cool" Steam Pressing Job

By ALFRED C. JUTZI
Assistant Chief Engineer
Skidmore, Owings & Merrill
Architects — Engineers

OPERATING a steam pressing machine in a clothier's plant is not the most comfortable job in the world. Considerable sensible and latent heat is dissipated by such a press from the steam which is used both to heat the pressing surface and to press the cloth.

Besides, the head of the press is a hot radiant surface which adds considerably to discomfort.

During hot humid weather, this becomes a question of immediate economics. In addition to the normal decline in worker efficiency, the rejection rate of finished garments by inspectors will be increased considerably, and it is not unusual for some garments to require pressing several times.

How Problem Developed

Such a situation was aggravated recently in the plant of The B. Kuppenheimer Co., clothing manufacturers, who modernized their operation by consolidating their entire pressing operation into one area for efficient production.

Working conditions which prevailed in this area during the first summer of operation were such as to make it mandatory that corrective measures be taken before a second summer season.

The pressing department is located on the third floor of a four story non-air conditioned mill type building. The structure has large areas of industrial type operating window sash on all four exposures.

A preliminary survey indicated three possible solutions to the problem: mechanical cooling, evaporative cooling, or a mechanical ventilating system.

Early calculations indicated a cooling load for this one floor of about 100 tons, or an estimated investment of approximately $100 thousand. The wisdom of such an investment was questionable, since the building, while in very good condition and well maintained, was 40 years old.

Also, it was suspected that once this area was cooled the same requirement would arise for the rest of the structure, at an estimated cost of $400 thousand.

Develop Second Estimate

Evaporative cooling was next considered. Investigation and a check on existing installations for similar jobs indicated that this might be a more practical and economical solution. Cost estimates approximated $40 thousand.

Mechanical ventilation was then evaluated. To circulate air about the press operators at sufficient velocity to maintain comfort would require a volume of about 200,000 cfm. Such a volume would be almost impossible to handle in this area, and the cost would exceed that for an evaporative cooling system.

Installation of exhaust hoods above each press did not appear to be a workable solution either. Hood size and the air velocity needed meant that about 200,000 cfm would still have to be circulated.

To allow the presses to operate, the hoods would have to be placed at a height where the effectiveness of capturing the steam vapors was questionable.

Set Tentative Plan

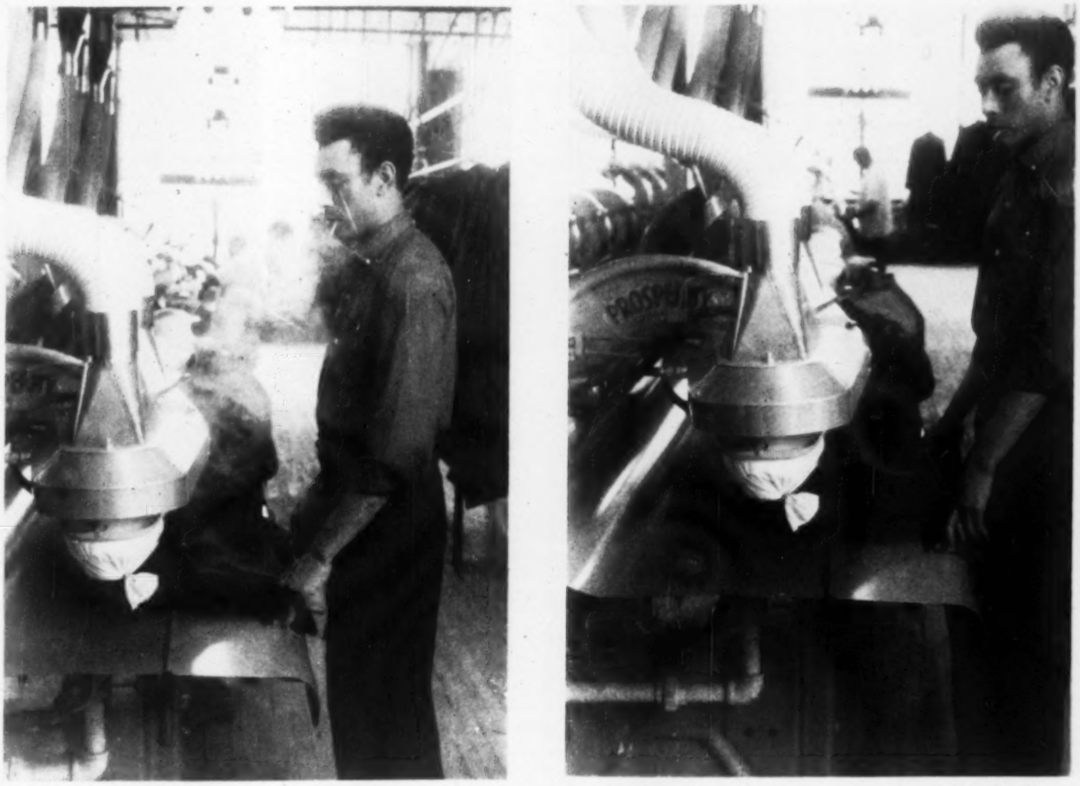
A review of all this indicated that an evaporative cooling system would provide the most comfort per dollar spent, and this system was recommended and conditionally accepted.

A subsequent check of the presses in operation, however, showed that a cool air supply system was not the complete solution. Something first had to be done to remove the steam vapors at their sources.

Evaluate Various Effects

Steam vapor was the worst offender. Sensible heat and the radiant surfaces of the presses were sources of discomfort to the operator, but did not have a detrimental effect on the finished garments. As an experiment in capturing the steam vapor, an aluminum hood was fabricated and attached directly to the movable head of one press, with a gap or air space between head and hood of 1½ in.

A duct connection was made at each end of the hood, to which 6 ft lengths of flexible tubing were attached. The two lengths were then coupled and connected to an exhaust fan. The double duct method was used because the hinge, piping connections, and controls were located in the center of the press head.



BEFORE AND AFTER conditions at steam press are shown above. At left, with integral exhaust system turned off, vapor is oppressive. At right, with system working, vapor is gone

Results with this experiment greatly exceeded expectations. It not only eliminated 80 percent of the steam vapor, but did away completely with the radiant effect from the head surface, and apparently removed the greater part of the sensible heat emitted from the press.

It was then decided to treat most of the large presses in a similar manner before further work on the cooling system. An exhaust system was designed and installed with the trunk ducts and fan sized to accommodate more presses in the future, if desired.

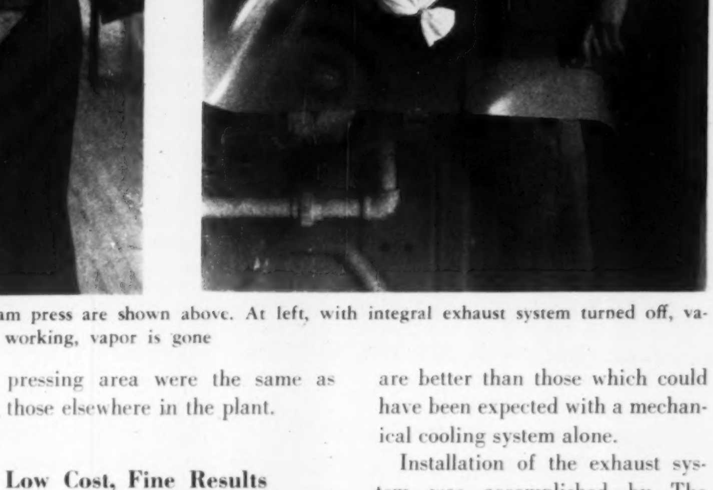
No Cooling Needed

The job was completed just before the start of the summer season. During the ensuing hot weather, results for both individual presses and the entire area were so satisfactory that it became unnecessary to install a cooling system. Conditions maintained in the pressing area were the same as those elsewhere in the plant.

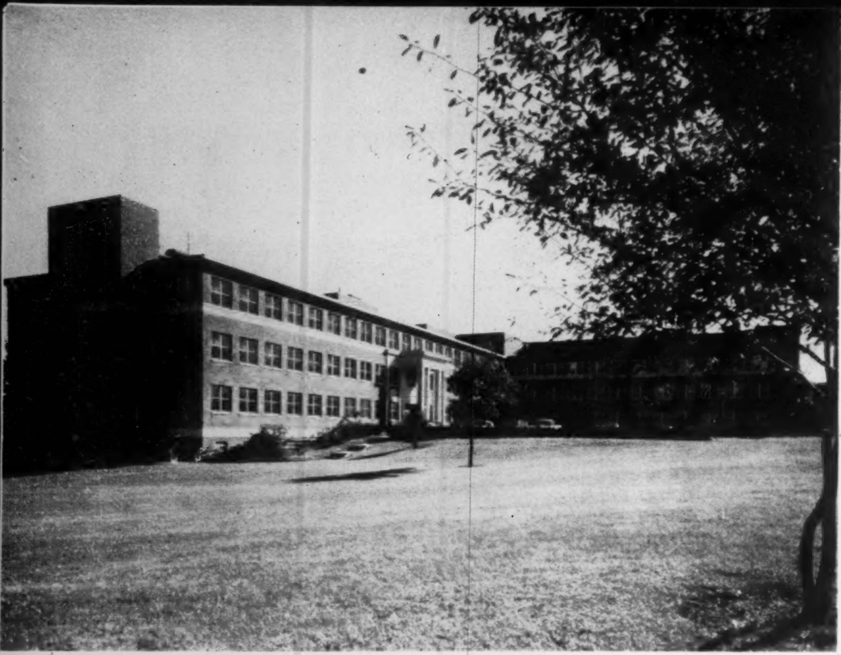
Low Cost, Fine Results

The cost of this installation was less than $11 thousand, and it is the general opinion that the results are better than those which could have been expected with a mechanical cooling system alone.

Installation of the exhaust system was accomplished by The Mehring & Hanson Co., heating, ventilating, and air conditioning contractors. ⁜



COMPLETED EXHAUST system for all presses eliminates need for mechanical cooling, keeps area conditions equal to those in remainder of building



Research building gets central air conditioning —

Install Year 'Round System While Tenants' Work Goes On

In 1951 Merck Sharp and Dohme, a division of Merck & Co., Inc., built a new four-story research facility in West Point, Pa. About 117,000 sq ft of floor area was gained for pharmaceutical research, animal rooms, and administrative functions.

At the time, only those laboratory spaces which required strict temperature or humidity control were air conditioned.

Later, additional areas in the building were cooled successively with a number of window air conditioners and small packaged units, until by 1959 almost one-third of the structure was being supplied with conditioned air.

This piecemeal increase gradually approached the capacity limit of the central chilled water installation, which serves nine other buildings on the plant site.

Decide on Centralization

After taking a long hard look at the situation, we decided to completely air condition the facility and to install a separate refrigeration plant to relieve the overtaxed existing chilled water supply.

The decision begot several problems — principal among them being the fact that research division activities were so vital to the company that they had to proceed uninterrupted, regardless of any construction that would be required. Therefore a far sighted plan of operations and close supervision were critical.

Need Capacity, Control

One of the most important design considerations involved a requirement for 100 percent outdoor air makeup in certain areas such as animal rooms. This indicated that the system would have to be of a high capacity, and capable of properly responding to greatly fluctuating loads.

Robert J. Sigel, Inc., of Philadelphia, designed a system with a central refrigeration plant supplying chilled water to air handling units serving each of the four floors. Hot water reheat coils

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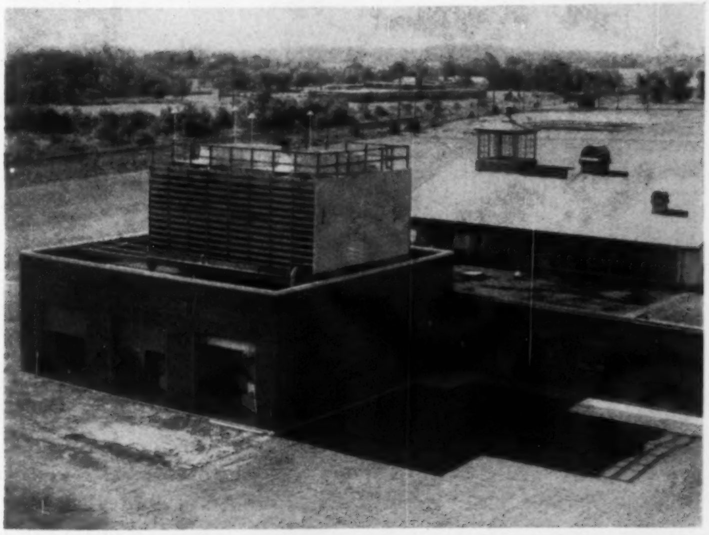
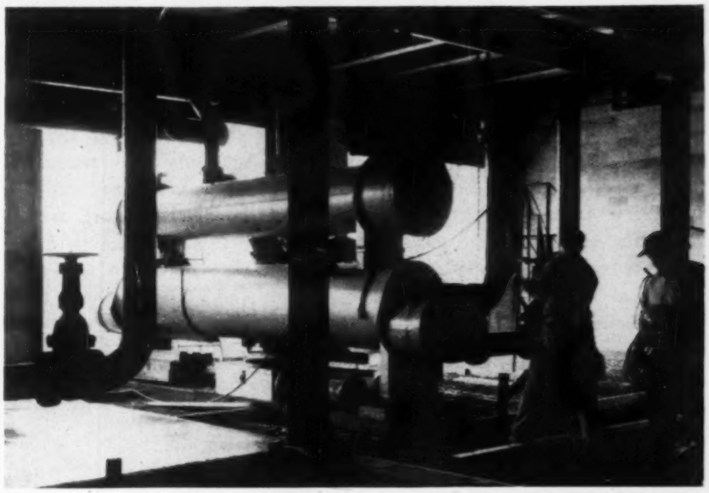
- When this pharmaceutical laboratory was built in 1951, only those small areas which required precise temperature or humidity control were air conditioned. Piecemeal additions of small individual units soon taxed the capacity of the existing multi-building cooling plant. In 1959-60, conversion to a central system was accomplished with a minimum of disturbance, and without interrupting laboratory work. Here's how.

By RICHARD W. RODNEY
Project Engineer
Merck Sharp & Dohme
Division of Merck & Co., Inc.



REFRIGERATION equipment is installed in separate garage-like annex behind research laboratory, with cooling tower on roof



TWO 330 ton capacity centrifugal chillers, water treatment facilities, and accessories are all installed behind wide doors which open directly to outside

AIR HANDLING unit with chilled water coil supplies entire floor with conditioned air through corridor ducts. Hot water reheat coils are installed near outlets to each room or zone

MAIN SUPPLY ducts are located in corridor ceilings, with outlets to rooms and zones as required

are installed in the supply air ducts near the outlet to each room or zone.

A reheat design was selected for several reasons. First, the fluctuating internal loads accentuated the need for some method of individual room control. Small individual room fan coil units were considered, but it was felt that these would lack the capacity to handle the large amounts of makeup air needed, both in animal rooms and other areas with large laboratory hood exhaust requirements.

Reheat coils were well adapted to easy concealment where required, as in some of the private offices, and in addition afforded the inherent advantages of good humidity control and positive year 'round conditioning. Besides, such a design could take advantage of existing ventilating units and ventilation ducts.

House Plant Separately

The refrigeration plant consists of two hermetically sealed centrifugal chillers, each of 330 tons capacity. These, plus the condensing and chilled water pumps, electric load center, water treatment facilities, and accessories, are housed in a new compressor building to the rear of the research building. The necessary cooling tower is located on the roof of the new structure, which is sized to accommodate an additional chiller of up to 600 tons capacity and a larger cooling tower, for future expansion.

Basic contracts were let in January 1959, and construction began immediately.

Plans and Operations

The only possible way of allowing laboratory work to proceed without serious interruption was to have all phases of the project closely scheduled so that research personnel would be aware of impending work in their areas well in advance. The owners acted as their own general contractor for the job, and let separate contracts for the mechanical, electrical, and building alteration work.

In order to make the proposed schedule most effective, an experienced construction engineer, L.M.G. Dangremond, was engaged to act as construction superintendent.

Finally, all work was planned in such a manner as to interfere as little as possible with the research operations. Before any drawings were begun, considerable time was spent in removing ceiling panels to check on the exact location of existing ducts and piping. All new and converted main distribution ducts are located in corridor ceilings.

This painstaking effort paid off in a minimum number of change orders for rerouting to miss unexpected obstructions.

Contractors were allowed to use elevators only at specified times. Utility shutdowns were tightly scheduled, usually after working hours. When corridor ceilings were removed, the panels were stacked in an orderly manner to keep corridors passable, even during the installation of new ducts. Temporary lighting was rigged where necessary; ventilating units were scheduled for change-over so as to deprive an area of ventilation for the least possible time.

In short, the job was scheduled and directed with the paramount objective of minimum disturbance to the occupants.

Idea Works Well

Generally speaking, the separate contract arrangement worked out very well. Work did in fact proceed smoothly, with little disruption or deviation from schedule. Since the construction superintendent could act as a direct agent of the owner, delays were minimized whenever slight deviations were necessary. The small amount of time lost in arriving at solutions and gaining approval helped to account for a relatively low cost per ton installed.

The final result was a job completed on schedule (the system was activated in June, 1960) with only slight disruption to the normal operations in the building.

Mechanical contractor for the air conditioning installation was the P. Gormly Co. ǂ

Directory of Addresses for Engineering Societies, Associations

Acoustical Society of America, 335 E. 45th St., New York 17, N. Y.
Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N.W., Washington 6, D. C.
Air-Conditioning and Refrigeration Wholesalers, 21877 Euclid Ave., Cleveland 17, O.
Air Cooling Institute, P.O. Box 2121, Wichita Falls, Tex.
Air Distribution Institute, 22 W. Monroe St., Chicago 3, Ill.
Air Filter Institute, Box 85, Station E, Louisville 8, Ky.
Air Moving and Conditioning Association, Inc., 2159 Guardian Bldg., Detroit 26, Mich.
Air Pollution Control Association, 4400 Fifth Ave., Pittsburgh 13, Pa.
Aluminum Association, 420 Lexington Ave., New York 17, N. Y.
American Boiler Manufacturers Association, 1180 Raymond Blvd., Newark 2, N. J.
American Concrete Institute, 22400 W. Seven Mile Rd., P.O. Box 4754, Redford Sta., Detroit 19, Mich.
American Forged Fittings & Flange Association, 333 N. Michigan Ave., Chicago, Ill.
American Foundrymen's Society, Golf and Wolf Rds., Des Plaines, Ill.
American Gas Association, 420 Lexington Ave., New York 17, N. Y.
American Industrial Hygiene Association, 14125 Prevost, Detroit 27, Mich.
American Institute of Architects, 1735 New York Ave., N.W., Washington 6, D. C.
American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.
American Institute of Plant Engineers, 4 W. Northwest Highway, Arlington Heights, Ill.
American Institute of Supply Association, Inc., 1505 — 22nd St., N.W., Washington 7, D. C.
American Meteorological Society, 45 Beacon St., Boston 8, Mass.
American Nuclear Society, 86 E. Randolph St., Chicago 1, Ill.
American Petroleum Institute, 1271 Ave. of the Americas, New York 20, N. Y.
American Rocket Society, 500 Fifth Ave., New York 36, N. Y.
American Society of Agricultural Engineers, 420 Main St., St. Joseph, Mich.
American Society for Engineering Education, University of Illinois, Urbana, Ill.
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 234 Fifth Ave., New York 1, N. Y.
American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.
American Society of Safety Engineers, 5 N. Wabash Ave., Chicago 2, Ill.
American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.
American Standards Association, 10 E. 40th St., New York 16, N. Y.
American Welding Society, Inc., 33 W. 39th St., New York 18, N. Y.
Anthracite Institute, 237 Old River Rd., Wilkes-Barre, Pa.
ARI Committee on Municipal Codes & Regulations, 1346 Connecticut Ave., N.W., Washington 6, D.C.
Association for Applied Solar Energy, Arizona State University, Tempe, Ariz.
Atomic Industrial Forum, Inc., 3 E. 54th St., New York 22, N. Y.
Automotive Air Conditioning Association, 4924 Greenville Ave., Dallas 6, Tex.
Better Heating-Cooling Council, 250 Park Ave., New York 17, N. Y.
Bituminous Coal Research, Inc., 121 Meyran Ave. at Forbes Ave., Pittsburgh 13, Pa.
Building Research Advisory Board, National Academy of Sciences-National Research Council, 2101 Constitution Ave., N.W., Washington 25, D. C.
Building Research Institute, National Academy of Sciences-National Research Council, 2101 Constitution Ave., Washington 25, D. C.
Clay Flue Lining Institute, 161 Ash St., Akron 8, O.
Clay Sewer Pipe Association, Inc., 311 High-Long Bldg., 5 E. Long St., Columbus 15, O.
Code for Pressure Piping, ASA Sectional Committee B31, Room 448, 420 Lexington Ave., New York 17, N. Y.
Committee of Steel Pipe Producers, American Iron and Steel Institute, 150 E. 42nd St., New York 17, N. Y.
Compressed Air & Gas Institute, 122 E. 42nd St., New York 17, N. Y.
Compressed Gas Association, Inc., 500 Fifth Ave., New York 36, N. Y.
Construction Specifications Institute, 632 Dupont Circle Bldg., Washington 6, D. C.
Consulting Engineers Council, 322 Reisch Bldg., Springfield, Ill.
Cooling Tower Institute, 1120 W. 43rd, Houston 18, Tex.
Copper and Brass Research Association, 420 Lexington Ave., New York 17, N. Y.
Copper Products Development Association, Inc., Time & Life Bldg., 1271 Avenue of the Americas, Rockefeller Center, New York 20, N. Y.

Diamond Core Drill Manufacturers Association, 122 E. 42nd St., New York 17, N. Y.

Edison Electric Institute, 750 Third Ave., New York 17, N. Y.

Electric Institute of Washington, Pepco Bldg., 10th at E Sts., N.W., Washington 4, D. C.

Environmental Equipment Institute, 33 Witherspoon St., Princeton, N. J.

Expansion Joint Manufacturers Association, 53 Park Place, New York 7, N. Y.

Fluid Controls Institute, Inc., P.O. Box 667, Pompano Beach, Fla.

Fuel Oil & Water Heater Manufacturer's Association, P.O. Box 151, East Greenwich, R. I.

Gas Appliance Manufacturer's Association, 60 E. 42nd St., New York 17, N. Y.

Gas Vent Institute, 322 S. Michigan Ave., Chicago 4, Ill.

Heat Exchange Institute, 122 E. 42nd St., New York 17, N. Y.

Heating-Air Conditioning Institute of Northern California, Room 853, Flood Bldg., San Francisco 2, Calif.

Hydraulic Institute, 122 E. 42nd St., New York 17, N. Y.

Industrial Gas Cleaning Institute, 23 W. 45th St., New York 36, N. Y.

Industrial Heating Equipment Association, Inc., 2000 K St., N. W., Washington 6, D. C.

Institute of Boiler and Radiator Manufacturers, Room 408, 608 Fifth Ave., New York 20, N. Y.

Institute of Environmental Sciences, P.O. Box 191, Mt. Prospect, Ill.

Institute of Heating & Air Conditioning Industries, Inc., 5107 W. First St., Los Angeles 4, Calif.

Institution of Heating and Ventilating Engineers, 49 Cadogan Sq., London, S. W. 1, England

Instrument Society of America, Penn-Sheraton Hotel, 530 William Penn Pl., Pittsburgh 19, Pa.

Insulation Board Institute, 111 W. Washington St., Chicago 2, Ill.

Insulation Distributor-Contractors National Association, Inc., 1425 Chestnut St., Philadelphia 2, Pa.

Liquefied Petroleum Gas Association, 11 S. LaSalle St., Chicago 3, Ill.

Manufacturers Standardization Society of the Valve & Fittings Industry, 420 Lexington Ave., New York 17, N. Y.

Mechanical Contractors Association of America, Inc., Suite 570, 45 Rockefeller Plaza, New York 20, N. Y.

Metal Ventilator Institute, 22 W. Monroe, Chicago 3, Ill.

Mines Accident Prevention Association of Ontario, Canada Permanent Bldg., 320 Bay St., Toronto 1, Ontario, Canada

Modular Building Standards Association, 2029 K St., N. W., Washington 6, D. C.

National Association of Building Owners and Managers, 134 S. LaSalle St., Chicago 3, Ill.

National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2, Tex.

National Association of Pipe Nipple Manufacturers, Inc., 501 Fifth Ave., New York 17, N. Y.

National Association of Power Engineers, Inc., 176 W. Adams St., Suite 1140, Chicago 3, Ill.

National Association of Practical Refrigerating Engineers, 6021 W. Addison St., Chicago 34, Ill.

National Board of Boiler & Pressure Vessel Inspectors, 1155 N. High St., Columbus, O.

National Association of Wholesalers, 1001 Connecticut Ave., N. W., Washington 6, D. C.

National Board of Fire Underwriters, 85 John St., New York 38, N. Y.

National Bureau of Standards, Mechanical Systems Section, Building Research Div., Washington 25, D. C.

National Certified Pipe Welding Bureau, Suite 570, 45 Rockefeller Plaza, New York 20, N. Y.

National Coal Association, Coal Bldg., 1130 17th St., N. W., Washington 6, D. C.

National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa.

National Electrical Manufacturers Association, 155 E. 44th St., New York 17, N. Y.

National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.

National Humidification Association, Inc., 20211 Harvard Ave., Cleveland 22, O.

National Insulation Manufacturers Association, 441 Lexington Ave., New York 17, N. Y.

National Mineral Wool Insulation Association, 1270 Sixth Ave., Rockefeller Center, New York 20, N. Y.

National Oil Fuel Institute, Inc., 60 E. 42nd St., New York.

National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

National Society of Professional Engineers, 2029 K St., N.W., Washington 6, D. C.

National Swimming Pool Institute, 48½ N. Ayer St., Harvard, Ill.

National Warm Air Heating and Air Conditioning Association, 640 Engineers Bldg., Cleveland 14, O.

NorthAmerican Heating & Airconditioning Wholesalers Inc., 1200 W. Fifth Ave., Columbus 12, O.

Perlite Institute, Inc., 45 W. 45th St., New York 36, N. Y.

Pipe Fabrication Institute, Room 759, One Gateway Center, Pittsburgh 22, Pa.

Plumbing-Heating-Cooling Information Bureau, 35 E. Wacker Dr., Chicago 1, Ill.

Producers' Council, Inc., 2029 K St., N.W., Washington 6, D. C.

Radiant Heating and Cooling Institute, Suite 318, 5657 Wilshire Blvd., Los Angeles 36, Calif.

Refrigeration and Air Conditioning Contractors Association, 1028 Connecticut Ave., N. W., Washington 6, D. C.

Refrigeration Research Foundation, 12 N. Meade Ave., Colorado Springs, Colo.

Refrigeration Service Engineers Society, 433 N. Waller Ave., Chicago 44, Ill.

Refrigeration Trade Association of America, Room 513, Perpetual Bldg., 1111 E St., N.W., Washington 4, D. C.

Sheet Metal and Air Conditioning Contractors National Association, Inc., 107 Center St., Elgin, Ill.

Society of Automotive Engineers, 485 Lexington Ave., New York 17, N. Y.

Society of Fire Protection Engineers, 60 Batterymarch St., Boston 10, Mass.

Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N.Y.

Standards Engineer Society, 170 Livingston Ave., New Providence, N. J.

Steam Heating Equipment Manufacturers Association, 635 Madison Ave., New York 22, N. Y.

Steel Boiler Institute, Inc., 1308 Land Title Bldg., Philadelphia 10, Pa.

Stoker Manufacturers Association, P. O. Box 669, Evanston, Ill.

Sump Pump Manufacturers Association, Mills Bldg., Washington 6, D. C.

Tubular Exchanger Manufacturers Association, Inc., 53 Park Pl., New York, N. Y.

Underwriters' Laboratories, Inc., 207 E. Ohio St., Chicago 11, Ill.

Uniform Boiler and Pressure Vessel Laws Society, Inc., 95 Liberty St., New York 6, N. Y.

United Association of Journeymen & Apprentices of the Plumbing & Pipefitting Industry of the United States and Canada, United Association Bldg., 901 Massachusetts Ave., N. W., Washington 1, D. C.

Valve Manufacturers Association, 60 E. 42nd St., New York 17, N. Y.

Vertical Turbine Pump Association, 400 Citizens Bank Bldg., 16 N. Marengo Ave., Pasadena, Calif.

Water Conditioning Foundation, 1201 Waukegan Rd., Glenview, Ill.

Welded Steel Institute, 1604 Hanna Bldg., Cleveland 15, O.

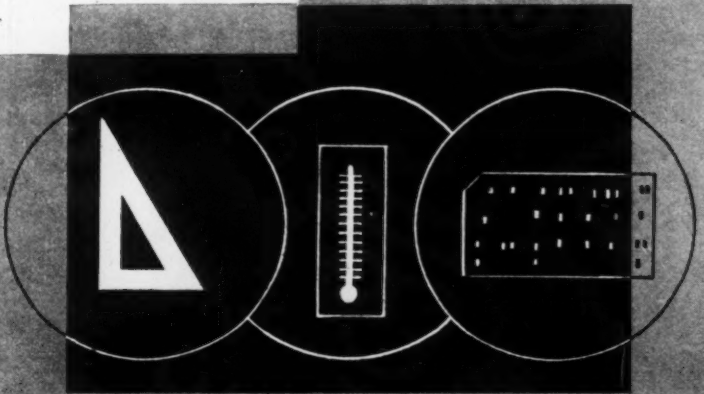
Western Air Conditioning Industries Association, 3443 S. Hill St., Los Angeles 7, Calif.

HPAC ENGINEERING DATA FILE

Preventive Maintenance of Air Conditioning Systems

What? When? and Why? to Check

- *The refrigeration system*
- *Heat transfer equipment*
- *Piping systems, pumps and valves*
- *The air handling system*
- *Electric motors*



Planned and scheduled inspections and repair are the heart of a preventive maintenance program. Proper planning requires an intimate knowledge of the system and its maintenance needs. What to inspect? How often? Why? These are some of the questions answered in this discussion of preventive maintenance of air conditioning systems.

By selecting from the suggested inspections and check lists given here, those that apply to a particular system, the foundation for a preventive maintenance program can readily be established. Because frequencies of inspection must be varied with age, severity of service, reliability required, environment, and abuse, this is only the starting point. The suggestions offered here must be adapted to local conditions through review of the PM program and its accomplishments.

Preventive Maintenance Assures Performance Of Air Conditioning Systems

MANUFACTURE, design, and installation all affect the ultimate maintenance burden of an air conditioning system, but none of these has as great an effect on maintenance costs as preventive maintenance or the lack thereof. In fact, a program of planned maintenance will eliminate over a period of time most deficiencies which can be attributed to design, installation, or manufacture.

Were it not for aggressive and dirty environments, friction and wear, vibration, and other forces which tend to cause the slow but continuous deterioration of a mechanical system, the system would require no attention during its life cycle. However, since these forces act upon all systems in varying degrees, only a carefully planned and executed maintenance program will assure realization of a well conceived system's potential and freedom from costly accidents to the major system components.

In a previous HPAC Engineering Data File[1], the essential elements of a successful preventive maintenance program (one which is well managed and controlled) were presented. One element of such a program is knowledge of the system needs and in this report, the special needs of air conditioning systems are explored in more detail.

Since every system, with few exceptions, has its individual characteristics only part of the information presented may apply to a specific system. However, selection of those that apply and inclusion of additional points that may be peculiar to the system at hand will provide an initial PM program which can and should be improved in time through good management.

Design for Adequate Space

To leave the impression that design does not affect future maintenance would be misleading. The recent emphasis of owners and their engineers on the need for operation and maintenance manuals prepared by the consulting engineer will tend to increase design responsibility insofar as maintenance is concerned.

Aside from proper application and selection of quality, maintenance free components within the economic limits established for the system, accessibility to components requiring maintenance remains a primary consideration. While the battle for adequate space is as old as the industry, nothing can thwart good maintenance as

Successful preventive maintenance programs include:

- **Good management maintenance policies**
- **An inventory of the plant**
- **Planned and scheduled work**
- **Standardized operation and maintenance procedures**
- **Trained personnel**
- **Adequately tooled personnel**
- **An adequate system of records**
- **Program for review of records, schedules, and reporting of accomplishments**

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[1] Numerals refer to references on page 170.

effectively as lack of accessibility. Particular attention should be given to providing easy access:

- In air distribution systems to permit inspection and cleaning of the ducts, bird screens, heating and cooling coils, dampers, condensate pans, and fans. Adequate space should be provided also to permit removal of the components that may require replacement or removal for repair.
- To pumps, valves, drains, vents and other piping system components which must be operated and maintained.
- Around shell and tube, and shell and coil heat exchangers to permit cleaning and removal of tubes for repair and replacement.
- To motors to permit cleaning, lubrication, repair and test.

While these are relatively obvious, a final check of the plans should be made to assure that components requiring maintenance have not inadvertently been placed in such a way as to make operation and maintenance difficult or impossible.

Installation Has Limited Effect

Installation also has its effect on future maintenance. Good installation practice and good workmanship are essential and some points to observe include:

- Keeping the interior of the piping systems as clean as practicable during erection to prevent damage to valves, pumps, etc. Rags, chips, scale, and other debris left in the piping can cause disastrous results. Cleaning of the piping system prior to start up is also necessary.
- Avoiding undue strains on piping due to misalignment. This may increase the maintenance of pumps and valves as well as the piping.
- Providing adequate support and making sure that hangers are neither too tight nor too loose.
- Making sure that threaded pipe does not enter valves due to improper thread depth.
- Making sure that the vapor barrier on lines carrying fluids at temperatures below the dew point is adequate and tight.
- Locating and orienting valves and strainers in the line to permit easy operation and maintenance.
- Carefully levelling compressor units to prevent distortion of the base and resultant misalignment of the drive.
- Keeping the air distribution system as clean as possible and cleaning it prior to start up when necessary.

Other precautions could be added to the above list but these are among the common causes of maintenance problems which are generated during installation.

What Needs To Be Maintained

An air conditioning system can be divided into segments in many different ways for the purpose of operation and maintenance. In this report, the system is divided into five major components:

1) The refrigeration system, including the compressor, refrigerant side of condenser and chiller or evaporator, refrigerant piping, and related controls.

2) The heat transfer equipment including cooling towers, evaporative condensers, air cooled condensers, air washers, and the water side of chillers and condensers.

3) The water piping systems including pumps and valves.

4) The air handling system including ducts, fans, dampers, filters, controls, and cooling coils.

5) Electric motors including those used on compressors, pumps and fans.

In establishing a PM program, it is considered good practice to locate and number each similar component and to maintain a record of the performance of each one. Such records are necessary for improving the preventive maintenance program and to isolate components which by reason of function, application, manufacture or other causes require excessive maintenance. Through proper record keeping, economic replacement, materials testing, and optimum inspection frequencies can be determined.

A review of the plans will provide the information as to types of components to be maintained, their location, and reveal something about their maintenance requirements. Reference to manufacturer's recommended maintenance procedures should be made for detailed information on each major piece of equipment. In this report, a brief review of the points that require surveillance is given, but areas which appear to be neglected frequently are discussed in more detail. Also, three phases of maintenance are considered: the time during which the equipment is operated, winter lay up, and start up in the spring.

The Refrigeration System

Many malfunctions of the various parts of a system are reflected back to the condensing unit and the symptoms of impending trouble are indicated as changes in operating pressures and temperatures. Consequently, a record of the suction and discharge pressures and other pertinent temperatures and flow rates, when instruments are available, are a useful tool. Constantly attended equipment is usually maintained by the operating crew and such information is recorded as a matter of standard operating procedure. However, in smaller capacity systems which are unattended such data are often not collected.

Provide Necessary Instrumentation

Minimum instrumentation would include suction and discharge gages on the compressor, an oil pressure gage on forced feed lubrication systems, and thermometers to measure water temperatures at the inlet and outlet of water cooled condensers, and at the inlet and outlet of water chillers. The data obtained from these few instruments are useful in predicting operational difficulties and thereby avoiding failures and disrupted service. They are also useful when laying a system up or putting it back into service. It should be noted that instruments also require periodic inspection and calibration if the data collected are to be meaningful.

The data listed above should be recorded each time the unit is inspected when a system is not constantly attended and daily or more often when under constant surveillance. The value of recording these data is enhanced when the person recording the information is capable of interpreting its significance or is made aware of the limits of acceptable operating conditions.

Inspect These Points Frequently

Some points to inspect in addition to recording the operating data include:

- Check compressor oil level and condition of oil (whether dirty or foamy).
- Check compressor for oil leaks.
- Check refrigerant charge.
- Check condition and alignment of compressor drive — belt drives should be checked most frequently for belt tension, alignment, and evidence of wear.
- Observe compressor and motor bearing temperatures and the operating surface temperatures of the compressor including crankcase, seal housing, and cylinder surface temperatures.
- Check for unusual noise and vibration.
- Test the refrigerant piping system and compressor for leaks.
- Lubricate motor bearings if motor driven.
- Check compressor rotation.
- Check operation of safety controls including high and low pressure cut-outs, oil failure switches on forced feed lubricated compressors, and crankcase heater thermostats.

How often these checks must be made will depend on a number of factors including: whether the compressors are operated and maintained by the building engineer or on contract with a service organization, the number of hours the system operates daily, and the reliability required. In general, checks of the first five items are made daily along with a record of operating pressures and temperatures when under constant surveillance and the remainder are made monthly. Under service contracts, the times vary but most manufacturers recommend that all of these be checked at least once a month.

When conditions deviate from normal, proven trouble shooting practices should be followed and corrective measures taken in accord with the manufacturer's recommendations.

Laying Up The Compressor

When cooling is no longer required, the refrigerant piping system should be pumped down. This should be done to prevent loss of refrigerant, and to relieve pressure on shaft seals and other components which may distort under constant load.

When the refrigerant has been pumped into the receiver or the condenser as the case may be, the valves at the inlet and outlet of the vessel should be closed, and the vessel and the connections to it should be checked for leaks.

The principal precaution to observe during the pumping down operation is to be sure that a positive pressure exists everywhere in the system. That is, the pressure measured at the suction side of the compressor should not be less than 1 to 2 psig at any time during the pumping down operation. A gage installed on the suction side of the compressor, as suggested earlier, will enable the operator to maintain the positive pressure desired. The purpose of this is to prevent the entry of air and moisture — two problems causing gases in refrigerant systems — into the system through seals and other potential leaks in valves, pipe joints, etc.

One other desirable step in the layup of belt driven compressors is to slack off the belts.

Make Annual Inspection In Depth

Between the time a system is laid up for the winter and prior to the beginning of the next cooling season, the refrigerant system should be given a thorough inspection. Preferably, the annual inspection should be made immediately following layup to facilitate scheduling any repairs, which may be necessary, prior to the next operating season. The annual inspection should be one in depth as this is often the only opportunity to check the condition and performance of many components. Here are some things to look for and take care of in an annual inspection which could cause an interruption in service and perhaps a costly equipment accident if not discovered.

Reciprocating Compressors

The reciprocating compressor is subject to wear and fatigue, and requires attention if it is to provide the service life which it is capable. In a recent report by F. W. Badger and J. F. Martin, The Hartford Steam Boiler Inspection and Insurance Co., accidents to and failures of 1246 reciprocating compressors were reported.[2] While the compressors studied handled air and ammonia, as well as fluorinated hydrocarbon refrigerants, the operating conditions are sufficiently similar to apply the results to any one of the gases. The initial parts involved in the failures and the direct causes of failure discovered in the investigation are listed in the accompanying table below.

The large number of failures attributed to valves, suggests the need[2] for removal of the heads to permit inspection and servicing of the valves annually. The valves should be carefully inspected for any evidence of minute cracks which may progress until the valve fails because of the many stress reversals that occur during operation. Metal fatigue was responsible for the

WHERE reciprocating compressors fail and the principal direct causes of failure as indicated by inspection of 1246 compressor failures are listed here

What failed	Number of cases	Percent of total
Valves	427	34
Bearings	293	24
Shafts	102	8
Connecting rods	17	1
Pistons	84	7
Piston rings	21	2
Cylinders	67	5
Cylinder heads	15	1
Fastening devices	85	7
Direct causes of failures		
Metal fatigue (progressive crack)	546	44
Inadequate lubrication	277	22
Liquid in cylinders	172	14
Misalignment	35	3
Improper adjustment	28	2
Improper operation	23	2

Abstracted with permission from The Locomotive[2] *of The Hartford Steam Boiler Inspection and Insurance Co.*

greatest number of valve failures. The importance of inspecting the valves annually is greatly emphasized by the fact that in 278 of the 427 cases of failures attributed to valves (about 65 percent of all failures) serious damage resulted to other compressor parts such as crankshafts, pistons, and cylinders.

While the heads are removed for valve inspection and servicing, the cylinder wear and evidence of cylinder scoring should be investigated.

Other preventive maintenance inspections required by reciprocating compressors on an annual basis include:

- Changing the oil if discolored and cleaning crankcase, accessible oil passages, strainers and oil filters.
- Check alignment of compressor drives and condition of sheaves and belts in the case of belt drives, and coupling wear and alignment for direct drives.
- Check operation of unloading devices.
- Check the condition of safety controls, tighten electrical connections, and clean, if necessary.

On the basis of the study mentioned above, it was further[2] recommended that the compressor be disassembled every two years or after 16,000 operating hours; whichever is shorter, to permit inspection and servicing of the compressor internals. Some things to look at in an every other year inspection include the following:

- Crankshaft for journal wear and signs of excessive bending stresses which may be due to misalignment of the compressor drive.
- Bearings for wear and other defects. Bearing wear may cause misalignment of the compressor drive.
- Connecting rods for signs of excessive stresses due to misalignment.
- Piston rings for wear and signs of fatigue. As in the case of valves, neglect of the piston rings may cause major failures in addition to the failure of the rings themselves. Maximum permissible wear should be obtained from the manufacturer.
- Pistons and cylinder walls should be inspected for scoring and if found, the cause determined.
- Oil passages and other parts of the lubrication system should be cleaned and inspected.

When reassembling the compressor, attention should be given to the condition of the fastening devices as indicated by the relatively large number of failures attributed to them. Principal causes of failures of these devices included,[2] "wear, improper repair, improper adjustment, and material defects." Reuse of onetime fasteners, loose keys, and loose fitting and worn bolts and nuts should be avoided.

Centrifugal Compressors

The annual checks of centrifugal compressors which can prevent disruption of service and possible failure include many of the same inspections, checks and services applied to reciprocating compressors. Among these are:

- Draining and changing oil and cleaning of oil reservoir filter and strainers.
- Inspection and service of refrigerant float valves.
- Checking of bearing wear and cleaning where possible.
- Inspection of drive for misalignment which may be caused by a settling foundation, or deterioration of grouting. Where speed reducers are used the oil should be drained and the gears inspected for indications of wear, pitting, misalignment, etc.
- Access caps to compressor internals should be removed to permit inspection and cleaning where possible.
- Disassemble purge unit, inspect and service, renew oil.
- Check calibration of instruments provided and adjust if necessary.
- Check safety controls for setting and operation, tighten electrical connections, and clean where indicated.

For more detailed information regarding inspections which can help prevent service interruptions reference should be made to the manufacturer's manual on the compressor installed.

Starting Up the Compressor

Assuming that the compressor has been inspected during the winter, the start up in the spring is essentially a reversal of the procedure followed in laying the compressor up. Sufficient refrigerant should be released into the system to permit a thorough testing of the system for leaks before releasing the whole charge. Leaks are difficult to repair once a system is in operation and a leak test prior to placing the full charge in the system can prevent an undue loss of refrigerant. A very slight charge of refrigerant with the system pressurized by an inert gas such as nitrogen can also be used for the preliminary leak test. Care should be taken, however, that the system is not pressurized in excess of manufacturer's recommendations to prevent damage to seals and other parts. Belts on belt driven compressors should be tightened and alignment checked. Once the compressor is in operation, the safety controls should be checked again to be sure that they function properly.

Clean and Treat Heat Transfer Equipment

Since the air conditioning system is basically a heat transfer machine, the components involved in the various heat exchange processes are especially important because of their effect on the operating efficiency of the system. Cleanliness and water treatment — to maintain efficiency and minimize corrosion — are the most important considerations in a preventive maintenance program.

Water Chillers

The chilled water side of the refrigerant system evaporator requires relatively little maintenance during the operation of the system. In fact, little can be done without disrupting service. However, an indication of the chillers performance can be obtained from records of inlet and outlet water temperatures and the refrigerant suction temperature. These will indicate any reduction in heat transfer efficiency, and potential freezing which could damage the chiller. The latter may be due to control malfunction, or failure of the control sensing element to respond to conditions necessary to freezing. Misplacement of the thermal bulb initially or a loosening of the element due to machine vibrations can occur and if not discovered result in poor control and freezing damage to the chiller.

Whether or not an evaporator should be opened annually to inspect and clean the water side of the tubes will depend upon the design of the chilled water system. If a system is designed[3] to prevent air intake into the system, minimum water losses, and no raw makeup water is added, the evaporator need not be opened. When these conditions are satisfied, the water quickly becomes inactive or passive due to the depletion of entrained oxygen, and fouling and corrosion will not occur. The system must, of course, be cleaned following installation and the pH of the water maintained between 7 and 8. Such systems should be drained and inspected only in the event of an emergency.

Before permitting the water chiller to operate without annual removal of the heads for inspection and cleaning, it is essential that it be determined that the system is truly tight. This can be done only by observing the amount of makeup water required. If an automatic makeup water system has been provided, it should be disconnected and makeup added manually until it is determined that the system is tight.

When the above conditions are not met because of pump packing gland leakage and other sources of leaks that require addition of raw makeup water, the heads should be removed annually and the tubes cleaned with a nylon brush or one of similar material and inspected for signs of corrosion. Water treatment to control corrosion becomes essential when a system is recharged with fresh water each year. Water conditions vary widely so treatment will depend to

MAINTAINING A CONTINUOUS BLOW-DOWN IS PROBABLY THE MOST IMPORTANT ITEM IN COOLING TOWER MAINTENANCE

some extent upon local conditions and the particular equipment involved.

Water Cooled Condensers

Like the chiller, little can be done to the condenser during operation except to observe its performance as indicated by water inlet and outlet temperatures and the head pressure and temperature. When the system is shut down, the heads should be removed and the condenser and tubes cleaned of mud, debris, scale, and other sediment that will collect during operation. This material is washed out of the air and tends to collect in the condenser. Tubes should be cleaned with a nylon brush or one of similar material and inspected for signs of corrosion. Where scale deposits are formed, chemical cleaning may be required.

If the condenser is exposed to freezing ambient temperatures, care should be taken to prevent freezing and damage of the tubes and headers. Since water can often be held in cavities in the heat exchanger, the condenser should be air blown to remove any trapped water. An alternate procedure to prevent freezing is to circulate an anti-freeze solution through the condenser. The concentration of the solution must be sufficient to prevent freezing when diluted with the trapped water.

Cooling Towers

Evaporation causes a concentration of dissolved solids in the circulating water. This is controlled by continuous bleed-off. A bleed-off rate of 1 percent for each 12 degrees of cooling range will maintain a concentration in the system that is double that in the supply water. Maintaining a continuous blow-down is probably the most important item in cooling tower maintenance. Supplemental water treatment may also be needed to control corrosion and scaling and to protect the wooden parts. Water treatment must be tailored to the specific installation and it is assumed here that an adequate water treatment program has been specified.

From the standpoint of preventive maintenance, the feeding of specified amounts of chemicals does not complete the job. Water quality should be checked periodically to assure that the correct level of treatment is obtained and the whole program reviewed annually to be sure that it is accomplishing its purpose.

In addition to periodic checks of the adequacy of the water treatment, the mechanical and electrical components of the tower or evaporative condenser should be checked periodically. Some of the inspections, tests, cleaning, and adjustments that will help to prevent undesirable failures include:

- Check nozzles and head pans and keep them clean to avoid clogging.
- Check water makeup float control valve and clean strainers and screens when necessary.
- Check and adjust pump packing and alignment of drive, and lubricate bearings.
- Inspect bottom of collecting pan and drain and flush when dirty.
- Check the interior of the tower for corrosion and slime, and hose down all loose deposits on eliminators and wood fill. Also, check fill to be sure that it has not shifted.
- Check condition of fan blades, fan rotation, lubricate fan and motor bearings, check belt drives for misalignment, belt tension, and condition of belts.
- In evaporative condensers, the tubes should be checked for scale and bird screens on inlet and outlet should be cleaned.

How often these periodic checks will have to be made depends upon the environment. They should be made weekly until experience dictates how frequently they will need attention.

Winter Layup Procedures

The precautions taken when laying the water cooling system up for the winter will add years to a systems life and prevent undesirable shut

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downs when cooling is required. Some of the things that should be done[4] when laying the system up include:

- Float valve or ball cock should be taken apart, cleaned, and rewashed.
- Interior of tower or evaporative condenser and tower packing should be washed down.
- Pans, pipe lines (including bleed and overflow lines), pumps and sump should be drained and flushed. If exposed to freezing temperatures, the components should be air blown to remove all water or an anti-freeze solution circulated through them.
- Strainers and screens should be removed and cleaned.
- The fans and drives should be carefully inspected for wear, corrosion, and other conditions which may cause service interruptions. Fan belts should be slacked off.
- If possible, fan and louver openings should be covered or screened to minimize the amount of airborne dirt carried into the tower or evaporative condenser during the winter.
- All metal parts exposed to weathering and those exposed to wetting and drying during summer operation should be coated with an alkali-proof paint formulated for metal surfaces.
- Packing should be inspected for deterioration and misplacement.
- The pump and motor bearings should be lubricated. The pump should be disassembled for inspection of bearings, impeller and casing when operating data indicate a loss of efficiency.

Spring Startup Procedures

Before starting up the cooling tower or evaporative condenser it is considered good practice[4] to do the following:

- Hose down and flush out the dust and grime that have accumulated during the winter on interior surfaces, wood fill, pans, etc. This should be done prior to filling the system. When completed, the water circuits should be thoroughly drained and flushed.
- Adjust the float valve or ball cock to close completely when the water level in the collecting pan is about 1 in. below the point of overflow. Operation should be checked to be sure there is no overflow with the sprays in operation and that the valve closes tightly when the sprays are off. The makeup water valve discharge should always be above the water level in the sump.
- Pump packing should be inspected, replaced if necessary, and adjusted to permit enough water leakage for lubrication and at the same time keep leakage to a minimum. The pump and motor bearings should be lubricated.
- Fan and motor bearings should be lubricated, the fan and motor cleaned, if necessary, and the belts adjusted and aligned. The fan blades should be inspected for excessive accumulations of dirt and hold down bolts tightened.
- Spray nozzles, perforated head pans, and strainers should be inspected and cleaned, if necessary.
- Metal surfaces should be inspected for corrosion and corrective painting done when necessary.

Air Cooled Condensers

Preventive maintenance of air cooled condensers during operating periods should include:

- Cleaning of the finned heat exchange surface.
- Lubrication of fan and motor bearings.
- Checking for evidence of corrosion of the joints between fins and tubes in environments which are conducive to corrosion, such as in installations near salt water.
- Functional check of controls for preventing low condensing pressures during periods of low ambient temperatures.
- Check for refrigerant leaks.

Cleaning is of the most importance and the frequency of cleaning must be adjusted to the needs of a particular location. A monthly check of the items listed above would be considered a minimum program of prevention.

Since the air cooled condenser is essentially laid up when the refrigeration system is pumped down, its layup requirements are minimal. Lubrication of fan bearings, cleaning of the fan blades and heat exchange surface would constitute the layup procedure. Prior to start up the same steps should be followed as when laying the condenser up and, in addition, it should be carefully tested for leaks, and a functional check of the controls made. Before the refrigerant charge is released to the system, any strainers in the refrigerant piping at the condenser should be cleaned.

Air Washers

Air washers when used for dehumidification have the problems of slime formation and corrosion but usually are not exposed[5] to scaling as some water is constantly taken from the air and an overflow to waste occurs. Water treatment would include that required for slime and corrosion control. Periodic inspection of the washer should include:

- Checking and cleaning spray nozzles.
- Cleaning the interior of the washer, sump, and eliminators and inspecting for evidence of corrosion.
- Lubrication of circulating pump and motor bearings.
- When fibrous fill is used in the washer it should be inspected and backwashed as needed.
- Checking and cleaning strainers in the water circuit.

Weekly cleaning and inspection of the air washer is considered adequate but experience may dictate longer periods between inspection. Since the air washer will usually be used year around no layup or start up procedures are indicated. However, between seasons a thorough inspection and cleaning will be advantageous and may prevent failure or inefficient operation during the alternate period of operation.

Water Piping Systems

Some comments have been made earlier about inspections and cleaning of water piping and related components such as valves and pumps. Since these components are rugged and simple in construction, they require a minimum of maintenance to assure satisfactory operation. However, they should not be neglected and periodic inspection and good housekeeping will extend their useful life and minimize unscheduled shutdowns.

Check Piping for Leaks, Corrosion

Due to vibrations induced by connected equipment, the joints in water piping systems are susceptible to developing leaks. During inspection of equipment piping in the equipment room should be checked for leaks or evidence of external corrosion. In the case of chilled water piping, the condition of the insulation should also be checked for possible breaks in the vapor barrier. Any evidence of moisture penetration of the insulation should be corrected immediately to prevent loss of insulation efficiency and possible corrosion beneath the insulation. The accessible portion of the piping systems should be checked annually for leaks and other evidence of deterioration.

When piping is exposed to freezing ambient temperatures, it should be drained and if proper pitch has not been provided the system should be air blown to remove any water trapped in low spots or fittings.

Pipe hangers should also be inspected annually to be sure that they have not come loose during operation. Should a hanger fail in the vicinity of a pump or valve, undue strain may be imposed upon the pump housing or valve with resultant damage to that part.

Consider Valve's Service

The type of service and the environment determine to a great extent what inspections should be made to keep valves in good operating condition. If the piping system is properly cleaned and adequate water treatment applied, stop valves will require little attention. Periodic inspection of the packing for leaks and replacement of the packing when it can no longer be maintained leak free will keep the valve in good condition. If water treatment is not properly applied or the system is dirty, wear, corrosion, and deterioration of the valve will occur more rapidly and disassembly for internal inspection and repair will be required periodically. How often will depend upon the severity of the service.

Valves used for manual throttling of flow should be opened for inspection, cleaning, and replacement of discs and seats that may be damaged by wire drawing. The performance of the valve will indicate when a disassembled inspection is required.

Automatic control valves should be checked for functional operation, packing leakage, and diaphragm leakage periodically. Considerable difference of opinion exists as to how frequently the automatic valve should be opened for inspection. Some engineers prefer to open the valve annually, others prefer to wait until malfunction occurs. The latter procedure is based on the premise that damage which can occur during opening and closing the valve may well offset any gains made by inspecting and cleaning the valve. Here again tests of performance should be the yardstick by which the frequency of internal inspections are made. Comparison of present operation with that when the valve was installed will generally indicate whether a valve should be opened.

Pump Performance Is Criteria

Periodic inspection of pumps has been mentioned earlier in connection with heat rejection equipment. Similar inspections should be made of all pumps in the system. During operation the following points should be checked periodically:

- Packing and mechanical seals for leakage. Packing should be tightened to minimize leakage but sufficient leakage should be permitted to lubricate the packing and shaft surfaces.
- Alignment of the drive and condition of the belts or couplings should be checked to prevent damage to the shaft and impeller.
- Bearings should be lubricated in accordance with manufacturer's instructions.
- Bearing temperatures should be observed for excessive temperature rise.
- Noise and vibration should be observed and steps taken to correct the condition causing it. Noise is often the result of cavitation which can damage the impeller and casing. Reducing the flow temporarily by partial closing of a stop valve in the pump discharge will stop noise if due to cavitation. Steps should be taken to restore adequate net positive suction head if cavitation exists.

Annual maintenance of the pump should include inspection and replacement of packing, if necessary, inspection of the condition of the pump shaft, and renewal of bearing lubrication. Bearings most often fail because of dilution and contamination of the lubricant and replacement annually is therefore desirable.

Pump performance as indicated by tests and pressure measurements should be the principal criterion for determining when to open a pump for internal inspection. Increases in horsepower, and decreases in head and capacity will result when internal wear becomes excessive.

Whenever pumps are exposed to freezing temperatures during the winter, they should be drained to prevent damage to the housing and internals. If by reason of design there is no assurance that the pump will drain completely, it should be air blown or flushed with an antifreeze solution.

Prior to starting up a pump in the spring, lubrication should be checked, packing adjusted, drive alignment checked, and if belt driven, the belt tension adjusted.

Maintenance of Air Handling Systems

The air distribution system contains many components that benefit from periodic inspections and tests. Among these are the fans, chilled water coils, dampers, etc.

The duct system itself should also be checked annually for need of cleaning, breaks in vapor barriers and insulation, loose and broken hangers, and leaking flexible connections. Access doors, drains and sheet metal housings should also be checked, cleaned and repaired when necessary. Bird screens or intakes and exhausts should be cleaned annually or more often as dictated by local conditions. Clogged screens are often the cause of improper and unsatisfactory ventilation. Since a wet cooling coil will wash dust from the air, condensate drain pans should be checked and cleaned to prevent clogging of the drain and resultant damage caused by overflow from the pan.

Fans Require Most Frequent Checks

Since the fan is a rotating piece of machinery, it of all the components of the air handling system requires the most frequent inspection in the preventive maintenance program. Some of the points that should be inspected monthly or more often as experience dictates include:

- Lubricate bearings and check for end play, excessive bearing operating temperature, and unusual bearing wear.
- Inspect housing and wheel for rust and accumulation of dirt.
- Check condition of drive couplings, sheaves and belts and align when necessary.

Annually, the fan should be inspected in greater detail. An annual inspection should include the following:

- Check fan wheel for damage and evidence of cracking of the blades. Clean the wheel of any accumulations of dirt which may cause unbalance and excessive vibration.
- Check bearings for wear and renew lubricant.
- Check to see that sheaves, fan wheel, and bearing collars are securely fastened to the shaft.
- Check alignment of drive and shaft for straightness.
- Check and tighten mounting bolts.
- Check housing and wheel for signs of rust and paint when necessary.

Multiple Leaf Dampers

The multiple leaf damper, while a simple control device, requires periodic attention to assure that it functions properly. Malfunction can lead to improper control of space temperatures, and inadequate ventilation. Check these points at least annually to keep them operating:

- Check for disconnected and loose linkages.
- Check leaves for distortion and damage, and clean when necessary.
- Lubricate pins and operators.
- Check functional operation to be sure that damper closes and opens to desired positions.

Chilled Water Coils

The wetted finned surface of a chilled water coil washes dust from the air passing over it. If this dirt is allowed to accumulate, heat transfer efficiency is impaired and air flow severely reduced. Thus, the condition of the surface should be checked periodically — at least once each month during operation. At the close of the cooling season or more often when needed, the finned surfaces should be cleaned with compressed air, other inert gas, or water. In the event that a coil has been permitted to become clogged with mud, it may be necessary to resort to the use of a detergent for proper cleaning.

Direct expansion coils require comparable inspection and cleaning. However, cleanliness is more critical in this case because inefficiency of the heat transfer surface is reflected directly to the condensing unit. The suction pressure drops causing inefficient compressor operation. Frost may form on the partially clogged coil to further decrease air flow and heat transfer.

During the annual cleaning of the coil, it should be inspected carefully for leaks, and evidence of corrosion and erosion. The casing should be inspected for rust, and cleaned and painted when necessary, and the coil mounting bolts checked and tightened.

If the chilled water coil will be exposed to low ambient temperatures during the heating season, precautions should be taken to prevent freezing and resultant damage to the tubes. Since surface tension in small diameter tubes may prevent complete drainage of a coil, the coil should be blown with air or flushed with an anti-freeze solution. Prior to start up the coil should be thoroughly flushed with clean water.

Air Filters

Because a number of different types of air filters can be employed, only the general maintenance needs of filters are given here. Obviously, a working filter must be cleaned to maintain the design air flow rate so inspections are directed to cleaning or replacing filter media when they become loaded to such an extent that pressure loss is excessive. Pressure drop through the filter, if recorded periodically, provides an excellent index of the need for maintenance.

The mechanical drives, of oil curtain filters and electrostatic filters should be checked for alignment, lubricated, and cleaned periodically. Reference to manufacturer's recommendations should be made for detailed information on inspections and service on the various types of filters.

Control Systems and Instrumentation

While the control systems are not necessarily a part of the air distribution system, the functions and physical locations of the two are so interrelated that they are considered here. During the course of operation, the conditions maintained in conditioned space give ample evidence of possible control malfunction. Periodic checks must be made of control set points and adjustments made when necessary. It is good practice to record any changes in set point as this information may be useful later in locating causes of improper operation.

Prior to starting a system up, a functional inspection should be made of the control system. By putting the control system through the possible conditions that will have to be met, operation of control valves, dampers, solenoid valves, etc., can be observed. When malfunctions are discovered manufacturer's recommendations should be followed in locating and correcting the source of trouble.

Emphasis has been placed upon the use of operating data to predict impending failures of mechanical components and loss of efficiency of heat transfer equipment in a system. Because the instruments themselves are subject to failure and malfunction, they too must be considered in the PM program. Periodic cleaning and calibration of gages, thermometers, flow meters, draft gages, etc. must be carried out if the data recorded are to be meaningful. Without periodic calibration, there will be no assurance that the inefficient or faulty operation discovered in this way are not due to instrument errors rather than equipment failure.

The compressed air piping system in pneumatic control systems require the same inspections outlined for other piping systems. Intake screens should be cleaned, piping checked for leaks, and moisture traps drained. The compressor should be inspected and serviced by following the same procedures listed for refrigeration compressors, including the annual inspection of valves, and the every other year inspection of all internal parts.

Motor controls, motor starters, relays, and other switches should be checked for arcing of the contacts, and all electrical wiring should be periodically checked for tightness of connections and condition of the insulation.

Preventing Failures of Electric Motors

The life of electric motors can be lengthened by periodic inspections, cleaning, and proper lubrication of bearings. That many accidents which befall electric motors are preventable was indicated in the report[2] by Badger and Martin mentioned earlier in connection with compressor maintenance. In their investigation of the direct causes of failures of about 3500 motors, it was found that moisture and accumulations of dirt, grease, and other foreign materials were often responsible for motor winding failures.

Some of the points to check to assure proper motor maintenance were outlined by M. J. Wohlgemuth, assistant to manager, service department, apparatus division, Westinghouse Electric Co. in a talk summarized[6] in a recent article. These are repeated here.

- Check for cleanliness of air passages and windings. Dust, dirt, grease, and other materials may clog air passages and thus contribute to overheating, attack insulation, and cause flashovers to grounds.

- Visually inspect the windings for condition of insulation but complement this with measurement of insulation resistance. The latter will indicate excessive moisture, and uncleanliness and deterioration not visible.
- Lubricate bearings in accordance with manufacturer's recommendations. If lubrication periods are neglected, the wrong lubricant used, or dirt permitted to get into antifriction bearings, failure of the bearing and possibly damage to the field coils and rotor may occur. The sleeve bearing is not as susceptible to damage from dirt as the antifriction bearing but cleanliness and proper lubrication are still good practice.

The above inspections should be made when the driven components are inspected. Other points to check in an annual inspection as outlined by Mr. Wohlgemuth include the following:

A-c motors

Stator windings

- General appearance, coil finish condition, and general cleanliness.
- Coil condition in slots, condition of wedges, and checks for wedge movement, loose wedges, and evidence of coil looseness.
- Coil condition in end winding, condition and tightness of blocks and spacers, condition and tightness of cord lashing, coil surface condition, condition with respect to possible distortion, compound migration, and insulation swelling.
- Evidence of corona or slot discharge distress (high voltage machine).
- Condition of core, tightness of laminations, cleanliness of ventilating ducts, and heating of finger plates.

Rotor windings

- For synchronous motors check for evidence of movement or shifting of coils, evidence of movement or looseness of poles, general cleanliness, condition of ground insulation washers, connections between coils and to collector, condition of collector insulation, and mechanical looseness of parts.
- For wound rotor motors check condition of wedges, wedge movement, for loose wedges, for coil looseness, end windage for distortion, end winding blocking and lashing, and rotor banding.
- For squirrel cage motors check for cracked rotor bars and check end rings for connection to bars.
- On all larger motors, air gap measurements should be taken periodically and recorded as an indication of bearing wear.

D-c motors

Stator or field

- General appearance, field coil condition, and general cleanliness.
- Coil tightness.
- Evidence of heating of connections of shunt fields.
- Evidence of heating of commutating and compensating winding connections.
- Tightness of current collecting ring and its connections.
- Check connections between the halves of the field frame.
- In brush rigging check to see if brushes are free in the holders, if brush tension device is operative and in good condition, and set to give proper brush pressure, if brush shunts are in good condition and if the shunt terminals are making good contact where bolted to the brushholders. Check for evidence of brush vibration or chatter. Replace any worn out brushes.

Armature

- Check commutator surface condition for roughness and smutty appearance and poor color, for eccentricity with dial indicator, and for improper bag edge bevelling, poor mica undercutting and burned bars.
- Check armature condition, especially as to cleanliness.
- Check for loose wedges.
- Check armature banding.
- Check cross connection joints for tightness.
- Check journals and bearings for wear and

high spots, and check oil rings for concentricity and for flat spots.

Select Those That Apply

In the preceding pages, maintenance check lists have been given for a number of components of air conditioning systems. Some apply only to central systems, some apply to both central systems and those employing package units. In any case, selection of inspections, tests, and other procedures that will apply in the system to be maintained will establish a base for a successful preventive maintenance program.

Frequencies given for the various periodic inspections have been found acceptable in many cases. However, good management of the preventive maintenance program requires continuous and critical review of the inspection frequency taking into account the economic factors involved. Over maintenance is expensive because of labor costs and too little maintenance will lead to costly repairs, disruption of service, and shortened service life. Somewhere between these two extremes lies the point of optimum maintenance which can be found only by analyzing the program and the results accomplished.

Repeated reference has been made to performance testing to establish criteria for determining when preventive maintenance inspections are required. The use of operating data to establish day to day performance, expecially in central systems, will promote economy in the preventive maintenance program. By comparing the cost of operation at various efficiencies with the cost of carrying out corrective maintenance procedures, optimum inspection and cleaning schedules can be arrived at for many components.

Left to its own devices, a system will soon fail to operate efficiently and satisfactorily. With a planned program of preventive maintenance, service life will be extended, costly equipment accidents will be eliminated for practical purposes, and good performance assured.

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McQuay

air conditioning equipment

Including the
New Single and
Multi-Zone
Air Handling
SEASONMASTERS

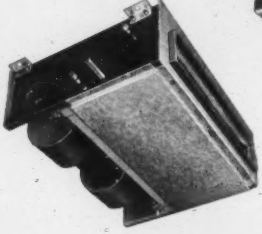
McQuay Means Quality

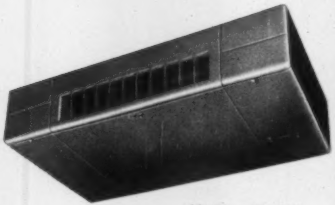
MAKE THE SEASONS
COME TO YOU

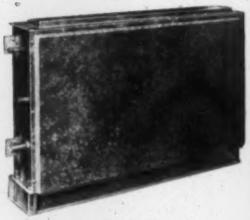
McQuay

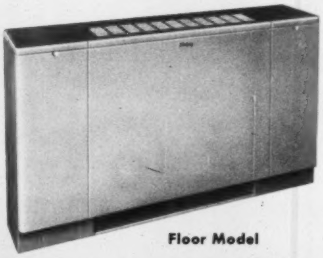
SEASONMAKERS

McQuay offers the finest in remote type, individual room air conditioners for use with a central station heating and cooling system. Extremely quiet, the "Seasonmaker" is available in floor, basic, ceiling and hideaway models in a wide range of sizes to meet your exact requirements. Floor and basic models range from 220 to 1240 cfm, and ceiling and hideaway models range from 220 to 640 cfm. Write for catalog 715.

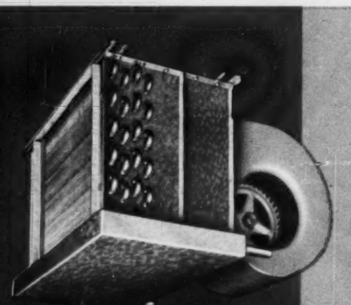

Hideaway Model


Ceiling Model


Basic Model


Floor Model

Ceiling Model


Hideaway Model

LARGE CAPACITY SEASONMAKERS

2 TO 10 TONS CAPACITY

Remote type ceiling suspended air conditioners for medium to large areas. Designed for fully recessed closet and false ceiling installations, or horizontally suspended in the conditioned space. The quiet, attractively styled McQuay large capacity "Seasonmaker" is available in four sizes of direct drive and five belt driven models. Write for catalogs 722 and 730.

McQuay

REMOTE TYPE AIR COOLED CONDENSERS

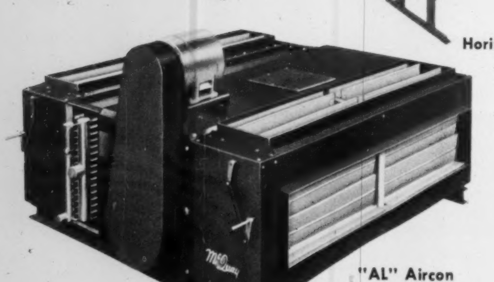
"AB" AIRCONS—Propeller fan types available in either horizontal or vertical air flow. Thirteen sizes each from 8 to 85 tons nominal capacity. Multiple installations make capacity unlimited. Write for catalog 629.

"AL" AIRCONS—Centrifugal fan types are designed for outdoor or indoor installations with or without duct work. They may also be used for exhaust ventilation and heating. Compactly engineered with a low silhouette, there is a wide range of unit and fan discharge arrangements. Write for catalog 635.

AUTOMATIC HEAD PRESSURE CONTROL
The McQuay type "AB" and "AL" Aircons are available with air side and refrigerant side head pressure control. The "AB" line is offered with opposed blade face dampers and corresponding controls for automatic operation.

Vertical Air Flow Aircon

Horizontal Air Flow Aircon


"AL" Aircon

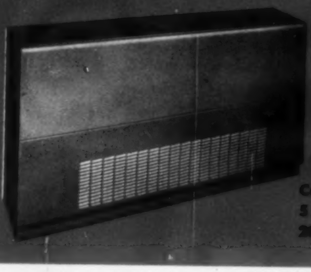
McQuay

UNIT HEATERS

Horizontal, downflow and cabinet type unit heaters are available in an exceptionally wide range of sizes and capacities for either steam or hot water. Adjustable louvers and several varied styles of air deflectors are available. McQuay cabinet type unit heaters are available for floor, wall and ceiling applications; for exposed, semi-recessed or fully recessed installations. Write for horizontal unit heater catalog 323, downflow unit heater catalog 765, cabinet unit heater catalog 351.

Downflow Unit Heater
22 sizes
25,400 to 610,000 Btu/hr.

Horizontal Unit Heater
24 sizes
17,700 to 360,800 Btu/hr.



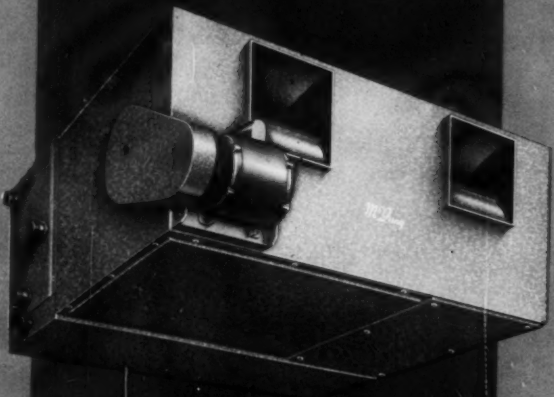
Cabinet Unit Heater
5 sizes
20,800 to 108,800 Btu/hr.

McQuay

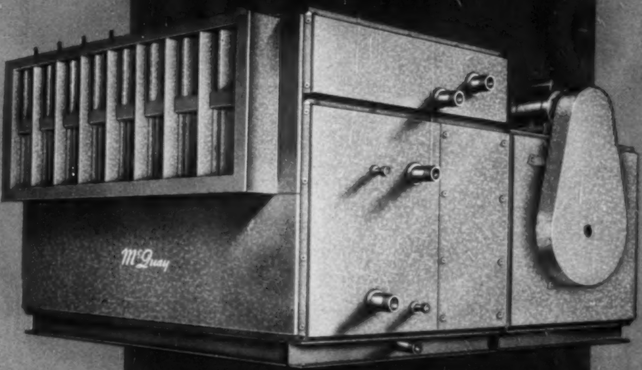
SEASONMASTERS

SINGLE AND MULTI-ZONE CENTRAL STATION AIR CONDITIONING UNITS

McQuay proudly offers a completely new line of quality engineered central station air conditioning units. A new space saving design, available in both single zone draw through and multi-zone or double duct blow through arrangements in low pressure (up to 3″ s.p.) and medium pressure (3″ to 5½″ s.p.), makes the McQuay line the most complete and versatile throughout the industry. Twenty-four models with multiple coil sizes insure the proper fan and coil combinations for every requirement. A full line of accessories is available. Write for catalog 560.



Horizontal Seasonmaster



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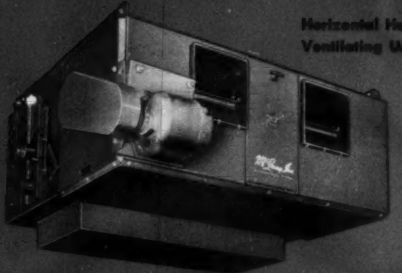
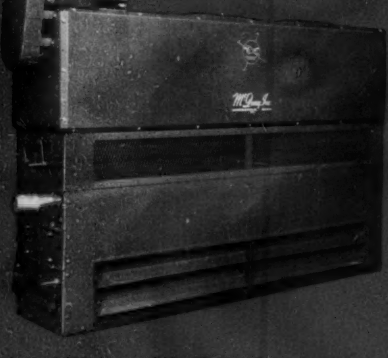
Vertical Seasonmaster

McQuay



Horizontal Heating and Ventilating Unit



Vertical Heating and Ventilating Unit

"HC" HEATING AND VENTILATING UNITS

For heating and ventilating, McQuay offers the most flexible line available anywhere. Designed for horizontal, vertical, wall and inverted installations for use with or without duct work to fill the needs of every installation. For use with hot water or steam, the McQuay line offers the widest range of coil selection in the industry, with capacities ranging up to 48,000 cfm and 3,320,000 Btu/hr. Write for catalog 344.

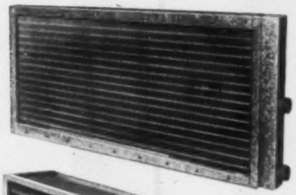
McQuay

RIPPLE-FIN COILS

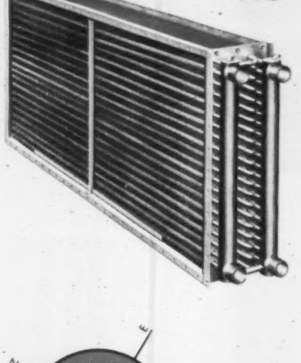
By the Nation's Largest Coil Manufacturer

A new type "5" coil design with a wide range of available fin spacings offers unlimited selection to meet all load requirements. This new design affords a new high in fin efficiency by attaining the highest heat transfer rate possible without excessive air friction. The combination of equilaterally staggered tubes and modified rippled fins produces maximum air turbulence, and intimate and prolonged contact between air and heat exchanger surface.

Direct expansion coils with pressure type distributors.

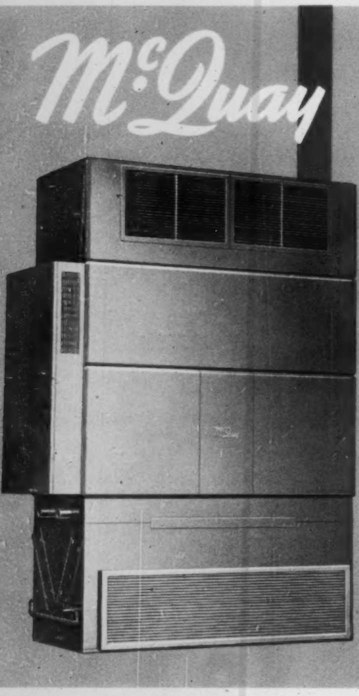


Pitched in casing steam coils. Easy installation and positive condensate draining.



Flow circuited water cooling and heating coils.

McQuay



SEASONVENT

The McQuay Seasonvent is a deluxe large capacity heating and ventilating unit engineered specifically for school auditoriums, theatres and similar installations where quiet operation is a necessity. The Seasonvent is extremely versatile with nine sizes for low static applications (0″ to 1¼″ s.p.) and seven sizes for high static installations (1″ to 2″ s.p.), with capacities from 1250 to 15,000 cfm. Write for catalog 575.

McQUAY, INC., 1600 Broadway N.E., Minneapolis 13, Minnesota

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AIR CONDITIONING • HEATING • REFRIGERATION

MAKE THE SEASONS COME TO YOU

DM—1961-2 Printed in U.S.A.

YARWAY Y news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*
BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD

WITH YARWAY GUN-PAKT EXPANSION JOINTS YOU NEVER HAVE TO SHUT DOWN STEAM LINES

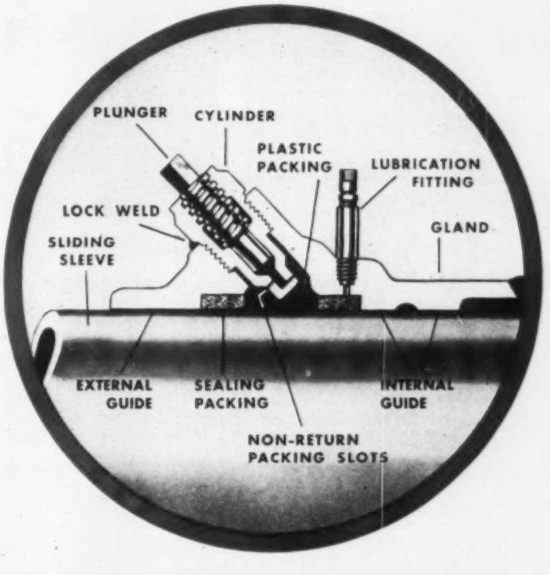
With Yarway Gun-Pakt Expansion Joints it is *never* necessary to shut down the lines to add packing to the joints. When additional packing is needed it is added *with the pipe line under full pressure.* A slug of plastic packing is inserted in the convenient screw-plunger gun—a turn of a wrench and the job is done, the joint is tight. Steam service is continuous. Costly shutdowns are eliminated. Joints never need repacking.

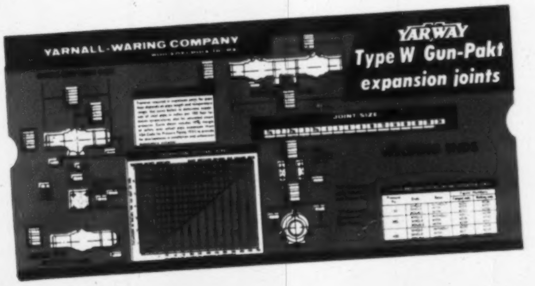
Yarway Gun-Pakt Expansion Joints give users these *extra* advantages, too:

- **Rugged dependability**—All-steel construction. Durable chromium plated seamless steel sleeves. *No chance of metal fatigue.* Wrought steel bases for positive anchorage.
- **Internal and external guides**—provide positive alignment in the stuffing box—*where it counts.*
- **Light weight, streamlined design**—requires less space to install, less space to maintain, smaller manholes.

Accept no substitute! Insist on Yarway Gun-Pakt—the original "packed under pressure" expansion joint, backed by 20 years of experience and thousands of successful installations to its credit.

For full information, and "blue chip" list of industrial plants, universities, institutions and central plants using Gun-Pakt Joints, write to Yarway.


PLUNGER
CYLINDER
PLASTIC PACKING
LUBRICATION FITTING
LOCK WELD
GLAND
SLIDING SLEEVE
EXTERNAL GUIDE
SEALING PACKING
INTERNAL GUIDE
NON-RETURN PACKING SLOTS


YARNALL-WARING COMPANY
YARWAY
Type W Gun-Pakt
expansion joints

QUICK ANSWERS TO EXPANSION JOINT PROBLEMS

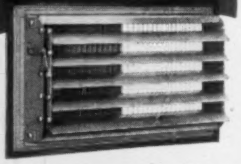
Want a *new* time- and labor-saving Yarway Expansion Joint Calculator which quickly provides sizes, weights, dimensions, anchor loads, etc. for Yarway Gun-Pakt Joints? Just call your Yarway representative and ask for one—or write us on your company letterhead and we'll see that one is delivered.

DIRECTED AIR FLOW at any angle with

INDEPENDENT "Fabrikated" AIR CONDITIONING REGISTERS

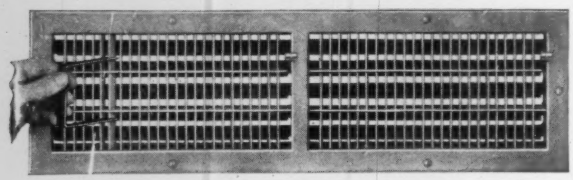
REG. U. S. PAT. OFFICE

321-A HMV



Rear View Showing "HMV" Valves

Every grille bar adjustable individually—before or after installation



321-A HMV Tandem

Any direction of air flow—right, left, up, down and any combination—is easily obtained with "Fabrikated" Style No. 321-A HMV air conditioning registers, for residence or commercial installations, on sidewalls or ceiling. The face bars are adjustable to right or left; valves on the back are adjustable to direct the air flow up or down; valves may also be fully closed, and are connected to open or close in unison.

The angles of deflection and the combinations to be had are practically unlimited. Adjustments for directed air flow may be made before or after installation. Grille bars are held firmly in place and will not vibrate or rattle. "Fabrikated" registers are available in sizes from 8 x 4" to 48 x 24", including tandem style. Special sizes can be made without special die set-up charges.
Write for Catalog.

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Shown here is our No. 330 BBC SWSI arrangement 1 Fan, with ratings certified by AMCA . . . just one of a whole family of efficiently-engineered Barry fans, giving dependable daily performance all over America.

All Barry fans are ruggedly built to give long dependable service. Such things as extra heavy framing, oversized shafts, heavy duty bearings, welded housings, TG&P shafts, and dynamically balanced impellors, are taken for granted by users of Barry blowers, because they know such construction is typical of the entire Barry line.

The fan shown is handling air in the asphalt plant of a large midwestern city at high pressure and high temperature. Whatever YOUR blower problem may be, there's a Barry fan that can solve it. Tell us your problem—we'll come through with the correct solution, plus speedy delivery!

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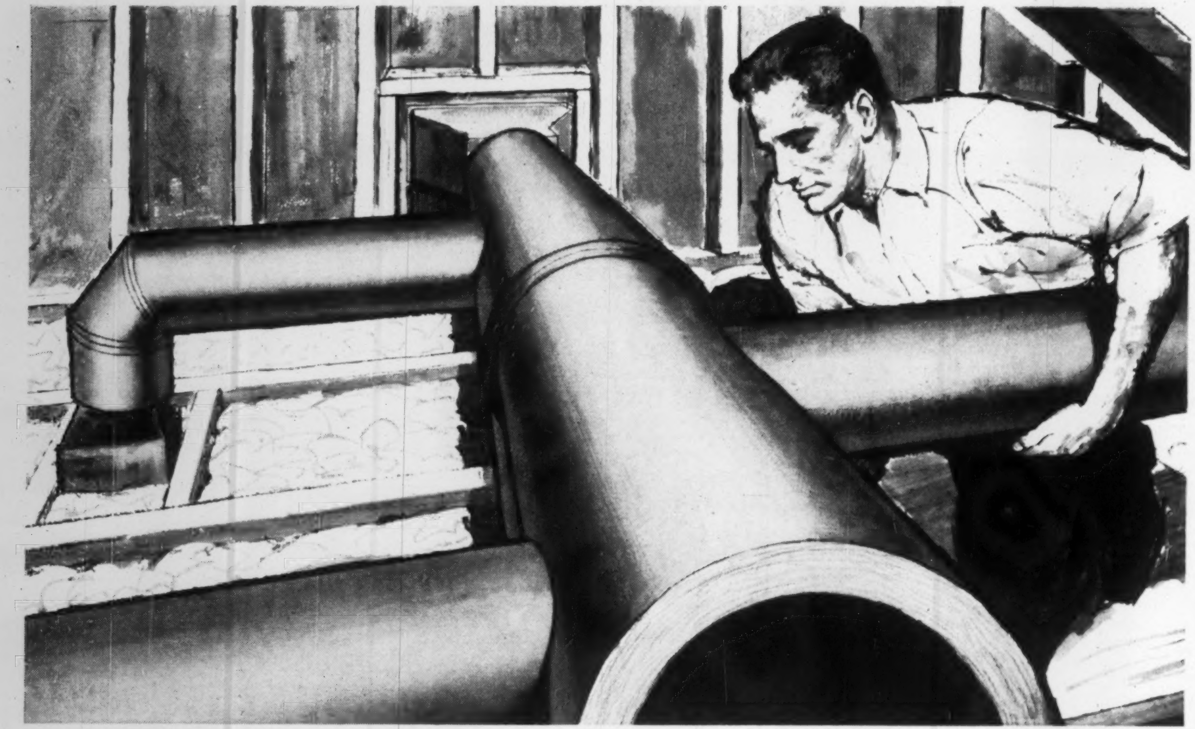

The duct that delivers air without noise

In air conditioning and warm air heating "quiet operation" has always been an expensive luxury. With conventional sheet metal duct systems, quieting fan and compressor noise or the "booming," caused by metal duct expansion and contraction, is a time-consuming and expensive job.

But with Armaglas Duct—the round prefabricated glass fiber duct system now available from Armstrong—the luxury of quiet operation is "built in"—still a luxury but no longer expensive.

Armaglas Duct is a natural sound trap. Its glass fiber walls "soak up" airborne fan and compressor noise for remarkably quiet operation. And since Armaglas Duct is non-metallic, it completely eliminates the "booming" or "canning" that's a common annoyance with sheet metal duct systems. This new material offers other important advantages, too.

Armaglas Duct is an all-in-one duct. It handles air efficiently. Uniform and permanent thermal protection is built in, because Armaglas Duct is preformed of thermally efficient glass fiber insulation in a uniform density and thickness. Vapor barrier is built in, too, in the tough plastic casing that forms the outer skin of Armaglas Duct. Duct, insulation, vapor barrier, and effective noise control are all combined in this one material.

Armaglas Duct comes ready to install. No folding—no preassembly is required.

It's easy to install. The six-foot sections go together fast, with simple metal sleeve connectors and pressure-sensitive tape at the joints. Job experience has shown installation time savings of up to 50% with Armaglas Duct. And this remarkable new system, with its many built-in values, costs no more installed than standard sheet metal duct plus insulation.

ARMSTRONG ARMAGLAS DUCT

For a free booklet with complete information on Armaglas Duct, write Armstrong Cork Company, 4405 Sherman St., Lancaster, Pennsylvania.

Armstrong ARMAGLAS DUCT

EQUIPMENT DEVELOPMENTS

Heating and Ventilating Units For School Room Application

"School-Vent" heats with steam or hot water and cools with central-source chilled water. Controls air flow instead of water for room temperature control. Features a full-damper system: face and bypass insulated damper directs air through and around heating coil; insulated anti-wipe damper permits isolation of coils for close temperature control; and indoor and outdoor dampers control blend of outside and recirculated air. Five sizes available up to 1500 cfm heating and cooling. Can be ceiling or wall mounted, partially and fully recessed or fully exposed. — *Modine Manufacturing Co.*, 1500 *DeKoven Ave., Racine, Wis.*

Condensers Available in $7\frac{1}{2}$ to 100 Ton Capacities

Air cooled condensers with horizontal or vertical air flow available in 19 sizes from $7\frac{1}{2}$ to 100 ton capacities in a single unit. For use with Refrigerants 12, 22, or 500. Automatic head pressure control for year 'round operation available with "Seasontrol" method or the "Dampertrol" method with opposed blade face dampers. — *McQuay, Inc.*, 1600 *Broadway, N.E., Minneapolis* 13.

Three-Pass Packaged Boilers Have Forced Draft Design

Packaged units with forced draft design available in 15 to 500 hp capacities. Fired by gas, oil, or gas-oil for low or high pressure steam or hot water. Front end can be cleaned without disturbing burner or fuel piping; rear access door for inspection without removing entire rear plate. Has full 5 sq ft of heating surface per boiler hp. Units are ASME coded. Bulletin 601 sent on request. — *Arkos Manufacturing Co.*, 7310 *Woodward Ave., Detroit* 2.

PVC Ball Valve Available in Sizes From $\frac{1}{4}$ Through 4 In.

Ball valve is a type I (normal impact) polyvinyl chloride (non-toxic, non-flammable) unit. Requires a quarter turn to operate. Corrosion resistant, low torque valve available in socket weld or threaded ends. Has external one-end adjustment. Bulletin sent on request. — *Walworth Co.*, 750 *Third Ave., New York* 17.

Air Cooled Condensers Have Coils Arranged in V-Shape

Remote air cooled condensers have coils arranged in a V-shape so that air is drawn through them and discharged upwards by the propeller fans. "V-Con" units have direct-drive fans, totally enclosed motors, and corrosion resistant aluminum cabinets. Available in capacities of 3 to 10 tons. Unit also available with centrifugal fan. Bulletin VC 103 sent on request. — *Halstead & Mitchell, Bessemer Bldg., Pittsburgh* 22.

INFORMATION on capacities, dimensions, applications, and special features in each EQUIPMENT DEVELOPMENT item is presented in accordance with material furnished by the manufacturers, who may be contacted directly for more details.

Other Departments . . .

- **Recent Trade Literature 241**
- **We Hear That 260**
- **Meetings and Conventions 266**
- **New Books and Reports 272**

EQUIPMENT DEVELOPMENTS

Continued

Butterfly Valve Has Snap-In Replaceable Rubber Liner

"Double R/L" butterfly valve for shut-off on vacuum service. Suitable for differential pressures up to 150 psi and temperatures from −60 to 400 F (depending on the type of elastomer liner selected). Has 125 lb ASA flanges. Sizes 2 through 12 in. available. Requires no lubrication. Liner with self-aligning shaft holes is mechanically installed and can be replaced. Bulletin 91 sent on request. — *Fisher Governor Co., P.O. Box 307, Marshalltown, Ia.*

Acoustic Calibrator For Noise Level Meters

Unit requires no source of power; operates on solely mechanical means. System of falling balls produces noise that covers a broad band of frequencies centered on 1500 c.p.s. Accuracy is within ±1 db. Unit produces noise level as high as 90 db at 4 in. from sound meter's microphone, eliminating effects of background noise in most cases. Temperature and/or humidity have negligible effects on performance. — *The Korfund Co., Inc., OIF Cantiague Rd., Westbury, N.Y.*

Urethane Foam Insulation For Temperatures to 190 F

Rigid urethane foam sheets for insulation of buildings, duct, pipe, equipment, and other applications. "K" value is 0.15 at 70 F and 0.13 at 40 F. Available in panels of various thicknesses up to 11 in. Blocks of foam for use as pipe insulation and lagging also available. Also comes in flame-retardant coated panels. — *Allied Chemical Corp., Barrett Div., 40 Rector St., New York* 6.

Packaged Boilers for High, Low Pressure Operation

Scotch type forced-draft packaged boilers for high and low pressure operation. Fired by light oil, gas, or gas-oil. Output ratings of 20 to 150 hp for high pressure; 672,000 to 5,040,000 Btuh for low pressure. High pressure units for 125 to 150 lb steam WP. Low pressure units for 15 lb steam WP and 30 lb water WP. Higher pressures available in both sizes. Features skid mounting; gas-tight front steel smokebox with gasketed cast iron doors; explosion relief doors; operating limit control; and safety high limit control. — *American Standard Industrial Div., Detroit.*

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EASY AS PLUGGING

That's how easy it will seem to install WhispAir*...the new Westinghouse central system cooling and heating unit designed for small buildings and low-cost homes!

Now you can install central cooling and heating for the lowest cost yet . . . so easily you can practically plug it in and forget it.

Amazing new WhispAir by Westinghouse is a true heat pump that supplies 18,000 BTU cooling and 17,000 BTU heating. Team up as many as you need . . . perfect for zone control. It fits snugly against an outside wall. Can be installed with or without ductwork and comes completely pre-wired, including thermostat.

WhispAir is ideal for hundreds of commercial and residential applications . . . stores, motels, offices, apartments, mobile homes . . . you name it! Your customers will love WhispAir. Turn the page and see why.

*TRADE MARK

Axial Flow Fans for Cooling Towers, Exhaust Units

Units in both belt and direct-drive models in nine standard diameters from 24 to 60 in. Blades are completely interchangeable. "R" series has blade pitches of 20, 27, and 40 deg. Specifications sent on request. — *The Torrington Manufacturing Co., Air Impeller Div., Torrington, Conn.*

Gas Conversion Burners Have Inputs to 1,050,000 Btu Per Hr

Series "26" atmospheric burners have inputs ranging from 600,000 to 1,050,000 Btu per hr. Each unit furnished with an automatic pilot or optional electronic pilot with flame electrode and M-H protectorelay, automatic main gas valve, and gas pressure regulator. Has formed steel mixers with stainless steel flame retainers. Burners can be used over stokers and over or under oil burners. For LP gas, a pilot can be furnished which provides 100 percent gas shutoff. An 8½ × 12½ in. opening is required for installation. — *Roberts-Gordon Appliance Corp., 44 Central Ave., Buffalo, N.Y.*

Relief Valves for Hot Water Heaters and Storage Tanks

Automatic temperature and pressure relief valve series for hot water heaters and storage tanks. Features a 6 in. thermostatic element. Available in two pipe sizes with relief capacities of 90,000 Btu per hr in ¾ in. size and 15,000 Btu per hr in ½ in. size. Bulletin 1-NFLX-1 sent on request. — *A. W. Cash Valve Manufacturing Corp., P.O. Box 191, Decatur, Ill.*

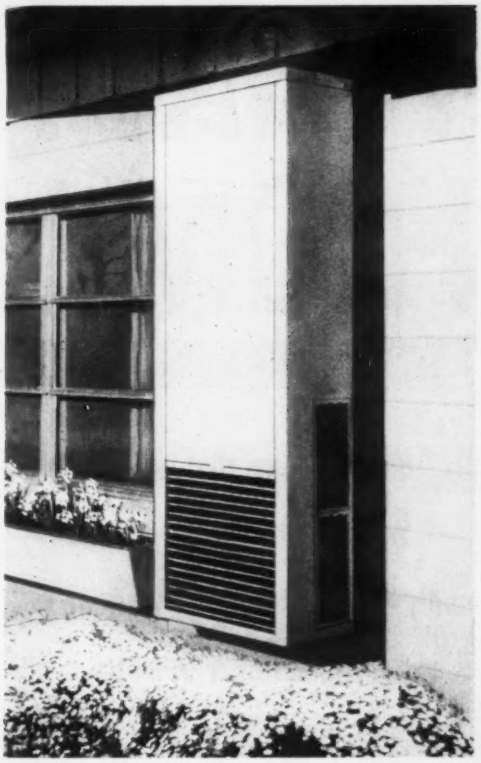
Control Valve Actuator Operates On Electric-Hydraulic Force

Electric control valve actuator uses an electromagnetic "pump" to move liquid metal which controls fan-coil units, convectors, and radiators. Actuator converts electrical energy into hydraulic force. Can be mounted in any position. Available in two-way model for hot water, cold water, or steam, and a three-way model for hot or cold water. Information sent on request. — *Minneapolis-Honeywell, Commercial Div., 2753 Fourth Ave. So., Minneapolis, Minn.*

QUITE) AS IN A LAMP

WhispAir

by Westinghouse



EQUIPMENT DEVELOPMENTS
Continued

Automatic Control, Indicator For Sump Pump Application

Automatic control system combined with a depth measuring device that shows depth of liquid in pit. Pumping rate compared with in-flow and indicated on instrument. Responds instantly to level changes in sump. "Vis-A-Trol" can be installed inside buildings up to 300 ft from pit. Bulletin AC-100 sent on request. —*Weil Pump Co.,* 4615 *N. Clark St., Chicago* 40.

Ball Valves for Hydrocarbon Service

Fire-safe ball valves for on-site process lines of refineries, petrochemical, and natural gas plants. Suitable for temperatures to 400 F. A secondary metal seat provides shut-off of fluid flow in event of loss of primary soft seats. Literature sent on request. — *Jamesbury Corp.,* 45 *New St., Worcester* 5, *Mass.*

Classroom Ventilator for Hydronic Application

Unit for use with primary-secondary pumping principle of water zone control. Can be installed in the center of an outside classroom wall with air distribution in utility bookshelf sections or wall duct sections along the entire outside wall. Cooling capacity is 40,000 Btu per hr with 40 F chilled water; heating capacity is 80,000 Btu per hr with 200 F hot water. Air delivery rated at 1200 cfm nominal standard air. Blower motor rated $\frac{1}{4}$ hp and secondary pump rated at 60 w so that total electric consumption is within 1/3 hp. Literature sent on request. — *Lennox Industries Inc., Marshalltown, Ia.*

Pocket Manometer Made of Unbreakable Plastic

Manometer suitable for water, glycerine, mercury, or oil for measurement in low-pressure gas systems. Designed to withstand rough usage. Open-ended and valved models available. Valved model with two brass needle valves permits fluid retention if desired; allows reading to be taken by unscrewing needle valve one-half turn. Available in five sizes from 6 to 18 in.; plastic tube has $\frac{3}{8}$ in. diameter for all models. Carrying case included. — *Gas Consumers Service,* 45-46 21*st St., Long Island City* 1, *N.Y.*

WHAT?? COOL AIR FROM NOWHERE??

It only seems that way...for WhispAir by Westinghouse cools and heats with or without ductwork, and without using an inch of floor space.

If any product ever sold itself, this one does. Defy your customers to detect the sound of air conditioning machinery indoors. Challenge them to find the source of all that cool, clean air.

Amazing new WhispAir*, the Westinghouse wonder that brings low-cost central system air conditioning and heating to your building or home customers . . . so quiet indoors, uses no floor space. It fits snugly against the outside of the building.

You can sell WhispAir with ease. It has the quietness and dependability of deluxe Central Systems. It is the lowest installed cost central system developed yet! Get all the details. Write Joe Cerny, Product Sales Manager, Westinghouse Air Conditioning, Box 510, Staunton, Virginia. *TRADE MARK

EQUIPMENT DEVELOPMENTS

Continued

Pipe and Vessel Insulation In Urethane or Styrofoam

Insulation has tight fitting butt and axial splines to facilitate installation. Under most conditions can be applied without adhesive. Available in urethane or styrofoam, either uncoated or asphalt coated. PVA coated in white, yellow, or green, or aluminum jacketed. Bulletin and sample on request. — *MMM, Inc. P.O. Box* 2114, *Houston.*

Packaged Fuel Pump Set For Industrial Fuel Oils

Unit performs multiple functions of fuel transfer, pressure boosting, and fuel straining in one operation. Includes a low speed rotary pump with a 2:1 ratio of fuel pumping to fuel burning: single or double "V" belt drive; basket type single or duplex suction strainer; vacuum gage; return-to-tank relief valve; discharge check and gate valves; and pressure checks. Unit pumps from 45 to 1000 gph, depending on motor selected. Has a 15 ft suction lift and 50 psi discharge pressure. — *Walter H. Eagan Co., Inc.,* 2336 *Fairmount Ave., Philadelphia* 30.

Flexible Flow Control Valve Automatically Actuated

Unit controls lines carrying highly abrasive slurries and corrosive materials. Has pipe-like body with unobstructed flow. A diaphragm motor permits automatic control. Available in a range of body materials including pure gum rubber, "Buna-S," "Buna-N," "Neoprene," and "Butyl," or compounds of each. Sizes range from 1 to 12 in. Connections include slip-on and flanged types. Catalog FL-1116R sent on request. — *Farris Flexible Valve Corp.,* 563 *Commercial Ave., Palisades Park, N.J.*

Flow Control Switch for Liquid and Gas Applications

Unit provides remote indication of preset flow rates of liquids and gases. Applications include starting and stopping pumps, valves, and alarms; controlling blending, mixing, filling, and emptying. Features stainless steel paddles, stems, bellows, and micro ball bearings. — *Power Equipment and Engineering Co., Inc.,* 1836 213th *St., Torrance, Calif.*

WhispAir*

by Westinghouse

toasting

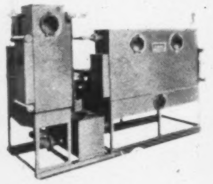
Continuous, automatic drying with air at precisely controlled temperatures up to 1000°F (for example, continuous toasting of cereal and other food products) is one of many processes in which Kathabar engineers are unusually experienced in the handling of both the air and the product.

drying

Continuous drying of heat-sensitive products (glue and gelatin, for example) is readily accomplished with Kathabar® equipment, using very dry air to remove moisture rapidly under precise control. Kathabar systems reduce cooling requirements, end condensation problems, operate continuously with low maintenance.

cooling

Continuous delivery of sub-freezing air down to extremely low temperatures, without frost or recycling, is one of Kathabar's unique capabilities, whether the air is for storage, testing, or processing. Data on Kathabar equipment for toasting, drying, or cooling is available promptly.



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company ....

street ....

city .... *zone* .... *state* ....

EQUIPMENT DEVELOPMENTS

Continued

Air Cooled Condensers Available In 2 to 120 Ton Capacities

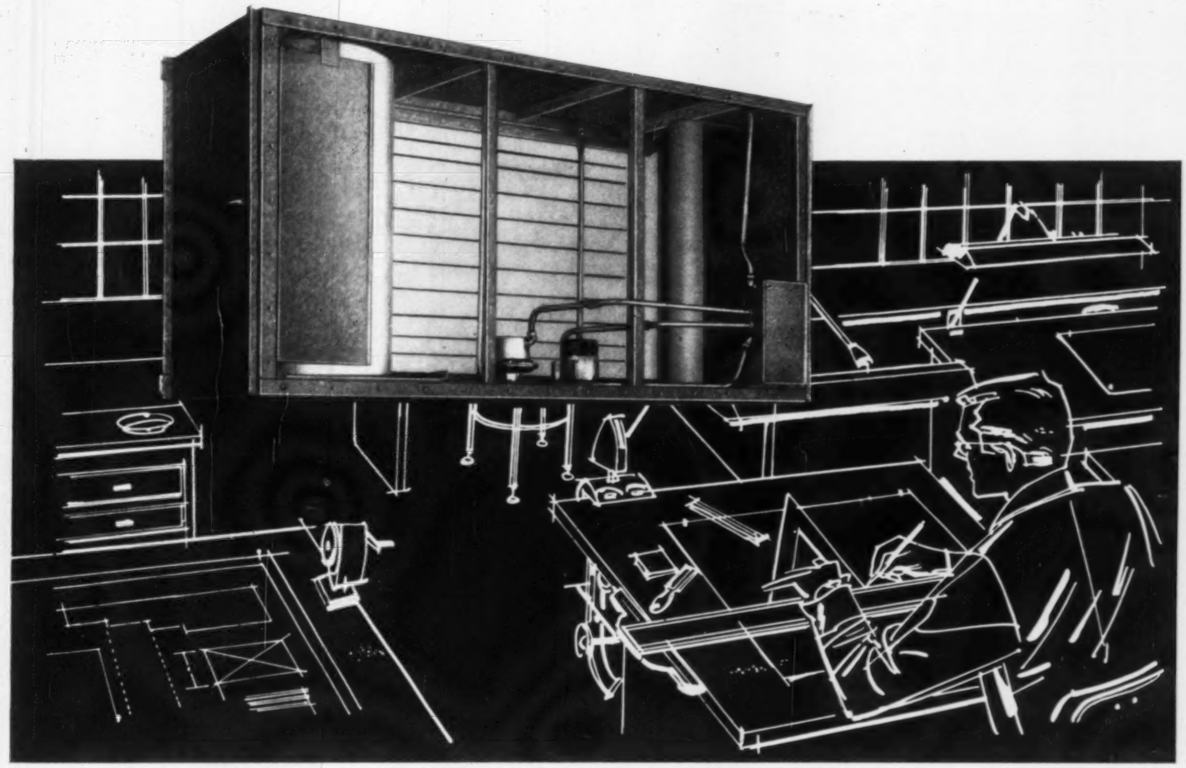
Units with 2 to 120 ton capacities available in vertical or horizontal models. Coils have eight fins per in. for low air pressure drop. Features all aluminum casing and galvanized steel structural supports; aluminum fins that have full collars; zinc coated chromate dipped wire fan guards; zinc plated chromate dipped steel shafts; zinc plated iridite dipped fans; and outdoor fan motors. — *Bohn Aluminum & Brass Corp., Danville Div., Danville, Ill.*

Incinerator Burners Have Up to 900,000 Btu Per Hr Input

Packaged units with input capacities up to 900,000 Btu per hr available in eight sizes. Gas-fired burners maintain flame temperature in excess of 1400 F. Two basic parts make up sealed unit: the burner and a preburned fire brick combustion block with cast iron flanged blockholder. Features automatically ignited pilot and a choice of three standard timers with time periods of 0 to 60 min, 0 to 6 hr, and 0 to 12 hr. Bulletin sent on request. — *Eclipse Fuel Engineering Co., 1139 Buchanan St., Rockford, Ill.*

Fan-Coil Units Available In Five Basic Models

Remote units for year 'round air conditioning for muti-room applications. Capacities range from 200 to 700 cfm. Floor or ceiling models available in cabinet or recessed types. Can be installed horizontally or vertically. — *Chrysler Corp., Airtemp Div., P.O. Box 1037, Dayton 1., O.*



CONOMATIC "TYPE GH" *Horizontal Roll Filter. . . .*

TO MAKE YOUR AIR SYSTEM TOTALLY AUTOMATIC!

Continental *creative* engineering has provided, in the CONOMATIC, a factory-assembled, automatic air filter that means real savings in construction, and assures superior operation of equipment on the job.

This automatic roll-type air filter will insure peak performance of your installation at all times and is virtually maintenance-free. May we show you how our Horizontal CONOMATIC will guard the efficiency of your equipment in service? Ask your Continental Agent or write us at P. O. Box 1647, Louisville 1, Ky., for Bulletin 822-A. *Clean Air Costs Less with Continental!*

- **Matches the job. 225 Sizes to choose from.**
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- **CONOMATIC Vertical Type "G" also available.**

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You'll save time, tempers and money when you use time-tested Silvercote fiber glass duct insulations with their exclusive facings and coatings.

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EQUIPMENT DEVELOPMENTS

Continued

Fan-Coil Units Available In 11 Different Models

Fan-coil units provide central-system air conditioning with individual room control. Available in 11 different types and six colors for offices, apartments, hospitals, and similar applications. Units will heat, cool and dehumidify, ventilate, or circulate air. Air flow capacities range to 1500 cfm. Optional equipment includes an automatic push-button lubrication system. Motors are mounted on rubber pads; low-speed fans have shock-absorber bearings. Insulation and mastic further deaden vibration. — *Modine Manufacturing Co.,* 1500 *Dekoven Ave., Racine, Wis.*

Air Diffuser Has Straight Line Design

Units for continuous wall-to-wall application, or can be used as an individual air diffuser. Slender unit has symmetrical vanes. Permits use of high temperature differentials. Information on "ASL" unit sent on request. — *Anemostat Corp. of America,* 10 *E. 39th St., New York* 16, *N.Y.*

Industrial Arc Welders for A-C Manual, Automatic Service

Units in 300 and 500 amp sizes have a 60 percent duty cycle rating. Employs a transformer with a movable coil design. Has 80 v open current for instant arc start and stability. Dual 230/460 voltage is provided. Optional equipment includes a primary switch, voltage reducer, and primary contactor with 115 v, push-button set control transformer. — *Air Reduction Sales Co.,* 150 *E. 42nd St., New York* 17.

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EQUIPMENT DEVELOPMENTS

Continued

Air Handling Units Built In Two Sections

Units with capacities ranging from 2000 through 15,000 cfm built in two sections: a fan section and a coil-filter section. Coil section can be turned end for end in the field or mounted horizontally adjacent to the fan section. Fan section built with a square cross section that allows unit to be rotated for a choice of discharge. Units can be installed horizontally or vertically. Uses either direct expansion or water coils; coils installed after unit is in place if desired. Steam heating coils can be added with a slide-in coil arrangement. Filters removable from either end of unit; choice of permanent or replaceable filters available. — *Chrysler Corp., Airtemp Div.,* 1600 *Webster St., Dayton* 4, *O.*

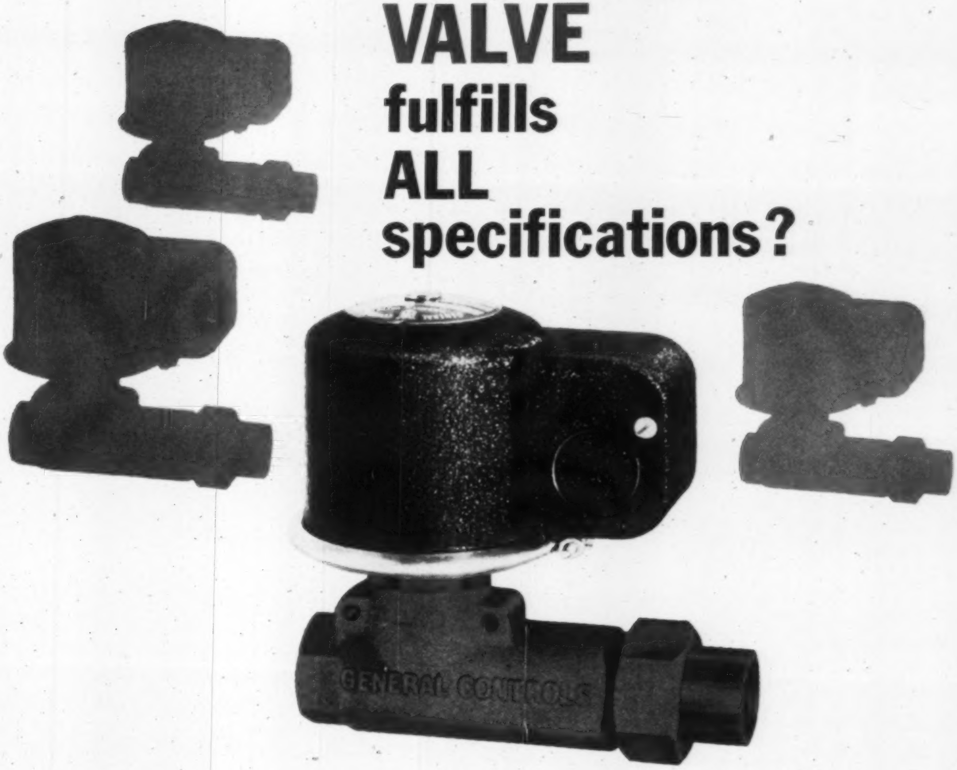
Sidewall Axial Belted Fan For Supply or Exhaust

Fan can be used either as a supply or exhaust by reversing the blade. "Sab-Line" available in sizes from 24 to 48 in. — *Greenheck Fan and Ventilator Corp., Schofield, Wis.*

Adjustable Suction Tube for Unit-Type Dust Collectors

Unit consists of a flexible fabric hose supported by arms that pivot to allow movement to any position. Assembly equipped with a dust nozzle. Available in 3 and 4 in. hose diameters, tube rotates through a full 360 deg and has an up and down travel of nearly 8 ft. — *Torit Manufacturing Co.,* 1133 *Rankin St., St. Paul* 16, *Minn.*

Which SOLENOID VALVE fulfills ALL specifications?



TEN REASONS why only GENERAL CONTROLS K-10 LEVER ACTING solenoid valves meet ALL your specifications:

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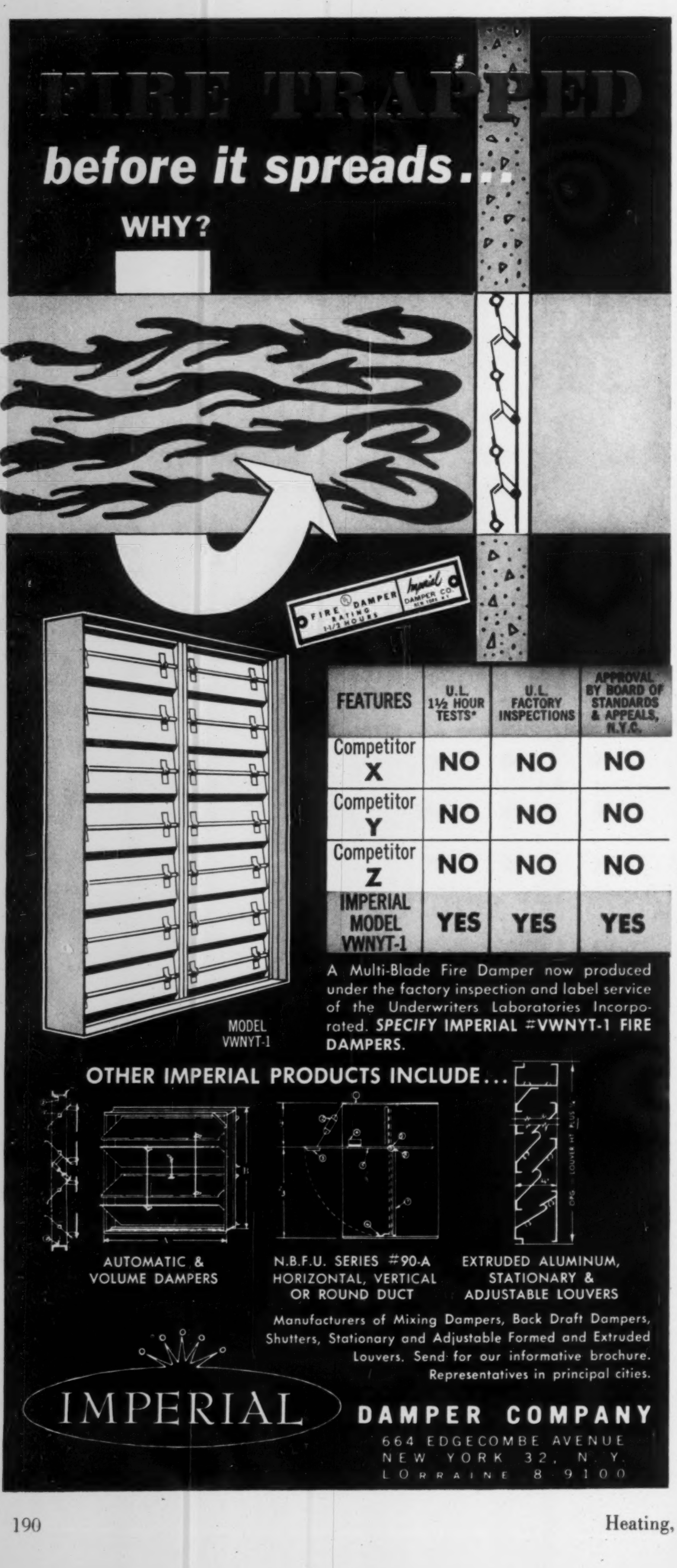
K-10	provides 3 sizes of Solenoids to handle *any* type of fuel oil...plus air, gas, steam, water, refrigerants, oxygen, nitrogen, ammonia, and others.	One (Small)
K-10	provides 4 classes of Solenoid coils for flow media temperatures from −60°F to 360°F...also waterproof types.	One
K-10	is available in many models, normally OPEN or normally CLOSED ...in combinations of solenoids, coils and body materials...choice of stainless steel or soft seats.	Some
K-10	resists corrosive fluids with optional *all* stainless steel lever acting solenoid valve.	No
K-10	operates under extreme pressures...up to 1000 psi.	No
K-10	includes built-in union for quick installation or removal without disturbing pipe line.	No
K-10	allows recirculation of heated semi-solid fuel *through valve body* when valve is closed to prevent sticking of internal mechanism.	No
K-10	has exclusive clamp ring coil jacket design for replacement of coils without danger of damaging other parts.	No
K-10	operates on simple 2-wire electric circuit—all voltages—AC and DC —explosion-proof housings.	Yes
K-10	is the *"original"* and only *complete* line of lever acting packless solenoid valves.	No

For complete information, check your classified telephone directory for nearest General Controls Factory Branch Office.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Competitor X	NO	NO	NO
Competitor Y	NO	NO	NO
Competitor Z	NO	NO	NO
IMPERIAL MODEL VWNYT-1	YES	YES	YES

MODEL VWNYT-1

A Multi-Blade Fire Damper now produced under the factory inspection and label service of the Underwriters Laboratories Incorporated. *SPECIFY* **IMPERIAL #VWNYT-1 FIRE DAMPERS.**

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Pneumatic Operators for Remote Actuation of Ball Valves

Air-powered operators provide automatic or pushbutton remote control of firm's ball valves. Vertically mounted units for valves from ¼ through 8 in. Totally enclosed, horizontally mounted cylinder-and-lever type operators available for all valves from 3 through 8 in. sizes. Both types integral with valve or available as separate units. Optional accessories include a solenoid valve for electrical control, limit switch for remote on/off indication, and a device to return valve to open or closed position in event of air system failure. Catalog 1200 sent on request. — *Hills-McCanna Co.,* 4600 *W. Touhy Ave., Chicago* 46.

Portable Drawing Instrument For Field Sketching

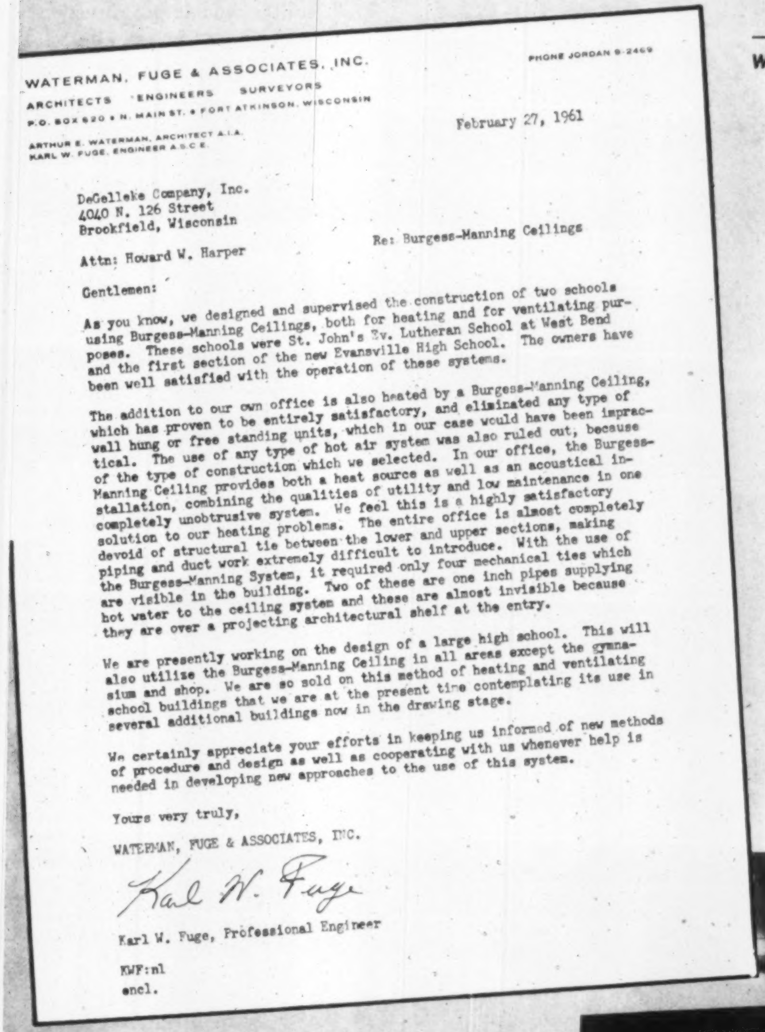
Pocket size drawing instrument serves the purpose of a rule, T-square, and angle. Made of polystyrene. Information sent on request. — *Country Engineer, Inc.,* 20 *Blueberry Lane, Darien, Conn.*

Floating Disc Steam Trap Has Only One Moving Part

Unit has a removable heat-treated stainless steel seat and disc. When installed vertically, with outlet downward, steam trap is self draining. Covers a range of 10 to 600 psi without adjustment. Provides intermittent discharge. A vent prevents air binding and discharges air as well as other non-condensibles. Furnished in either carbon steel or stainless steel. Bulletin "FD" sent on request. — *The Clark Manufacturing Co.,* 1830 *E. 38th St., Cleveland.*

"We are sold on this method of heating and ventilating..."

—*Karl W. Fuge, Engineer A.S.C.E.*
Waterman, Fuge & Associates, Inc.



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PHONE JORDAN 9-2469

February 27, 1961

DeGelleke Company, Inc.
4040 N. 126 Street
Brookfield, Wisconsin

Attn: Howard W. Harper

Re: Burgess-Manning Ceilings

Gentlemen:

As you know, we designed and supervised the construction of two schools using Burgess-Manning Ceilings, both for heating and for ventilating purposes. These schools were St. John's Ev. Lutheran School at West Bend and the first section of the new Evansville High School. The owners have been well satisfied with the operation of these systems.

The addition to our own office is also heated by a Burgess-Manning Ceiling, which has proven to be entirely satisfactory, and eliminated any type of wall hung or free standing units, which in our case would have been impractical. The use of any type of hot air system was also ruled out, because of the type of construction which we selected. In our office, the Burgess-Manning Ceiling provides both a heat source as well as an acoustical installation, combining the qualities of utility and low maintenance in one completely unobtrusive system. We feel this is a highly satisfactory solution to our heating problems. The entire office is almost completely devoid of structural tie between the lower and upper sections, making piping and duct work extremely difficult to introduce. With the use of the Burgess-Manning System, it required only four mechanical ties which are visible in the building. Two of these are one inch pipes supplying hot water to the ceiling system and these are almost invisible because they are over a projecting architectural shelf at the entry.

We are presently working on the design of a large high school. This will also utilize the Burgess-Manning Ceiling in all areas except the gymnasium and shop. We are so sold on this method of heating and ventilating school buildings that we are at the present time contemplating its use in several additional buildings now in the drawing stage.

We certainly appreciate your efforts in keeping us informed of new methods of procedure and design as well as cooperating with us whenever help is needed in developing new approaches to the use of this system.

Yours very truly,

WATERMAN, FUGE & ASSOCIATES, INC.

Karl W. Fuge

Karl W. Fuge, Professional Engineer

KWF:nl
encl.

First hand experience—an installation in their own office—is a solid enough reason why Waterman, Fuge & Associates, Inc. are *"sold"* on the Burgess-Manning Radiant Heating, Cooling and Acoustic Ceiling.

And . . . this is why this prominent Wisconsin architectural and engineering firm are continuing to utilize the Burgess-Manning Radiant Ceiling on their jobs now in the drawing stage . . . and, of course, on their future jobs, too.

For *better buildings* . . . with the *budget no bigger* . . . specify the Burgess-Manning Radiant Heating, Cooling and Acoustic Ceiling . . . it has many real dollar-and-cents advantages and assured design flexibility.

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GOODALL *Rubber* **EXPANSION JOINTS**

Flexible, durable connections for pipe lines and other equipment handling fluids and gases under pressure and vacuum, to prevent excess stresses due to expansion and contraction; to counteract vibration; and to insulate against undesirable sound. Can also be designed to overcome misalignment.

EASIER TO INSTALL—on new equipment or as replacements. Light in weight, with short face-to-face dimensions. Metal retaining rings quickly aligned and bolted. No gaskets required.

LONGER SERVICE LIFE—no embrittlement or corrosion. High resistance to abrasive wear.

STYLES, SIZES AND PRESSURES TO MEET ALL REQUIREMENTS

GOODALL *Rubber* **ABSORBER UNITS**

Easily installed units engineered to "absorb" vibration, water hammer and other undesirable sound, or where lines are subject to corrosion, abrasion or electrolysis. Light in weight yet exceptionally tough and durable. Installed with two male couplings or molded rubber flanged ends with split steel flanges. Hose can be furnished plain or with built-in wire reinforcement, for suction or discharge.

SPECIFICATIONS: Acid- and abrasive-resistant rubber tube; abrasion- and weather-resistant cover; sizes 1½" through 12" I.D., in lengths of 12", 18", 24", 36" and 48".

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Electrostatic Precipitator Has Flat Collection Plate Design

Unit utilizes modular construction and is built to specification. Flat collection plate contains pockets that trap and hold dust, reducing the chance of re-entrainment. Choice of four types of high voltage rectifier available: silicon; selenium; high voltage vacuum tube; or mechanical. Control can be a saturable reactor, a monocyclic network, or a resistor type. Unit is of all-welded construction with structural frames, side casings, end panels, and hoppers made from heavy gage steel plate. — *American-Standard Industrial Div., Detroit 32.*

Slot Type Air Diffusers Available in Extruded Aluminum

Units have separate frames and removable cores. Available in two styles of frames and three types of removable cores with diffusing vanes. For ceiling, wall, and window-sill installation. Diffusers made in sections and can be used as a continuous unit by butting sections together. Technical catalog ES-105 sent on request. — *Air Devices Inc., 185 Madison Ave., New York.*

Aluminum Damper Has Airfoil Double Blade

Aluminum damper has blades that contain no hardware. Use of vinyl stripping aids in making units airtight. When closed, double blades act as an insulator. Blade widths vary from 5 to 9 in. with any blade length available. Pinlock groove design facilitates blade turning. Units do not require painting. — *Arrow Louver & Damper Corp., 72 Berry St., Brooklyn 11, N.Y.*

Figure on FAST DUCT INSTALLATION with

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SONOAIRDUCT®
FIBRE DUCT

Bidding a slab perimeter heating, cooling, or combination system? You can figure on saving time and labor installing ductwork when you use SONOAIRDUCT Fibre Duct!

Lightweight SONOAIRDUCT handles easily, levels and joins quickly. Long lengths mean fewer joints. And, SONOAIRDUCT can be cut to size or mitered with an ordinary hand saw—right at the job. No sharp edges, either!

Easy to install, sure. But that's not the *only* reason why SONOAIRDUCT is America's best selling Fibre Duct—year after year. It's low in cost. It's rugged—won't chip, crack or break when dropped, so every piece is usable. And, you can depend on highest quality. SONOAIRDUCT has been performance-proved in thousands of installations, and meets or exceeds all F. H. A. criteria and test requirements for this type product.

Bid lower—profitably—on your next slab perimeter job with SONOAIRDUCT Fibre Duct. Available in 23 sizes, 2" to 36" I.D., standard 18' lengths or as required.

FREE INSTALLATION MANUAL

Contains latest, detailed, step-by-step installation data for SONOAIRDUCT Fibre Duct. For free copy, send us your name and address on company letterhead.

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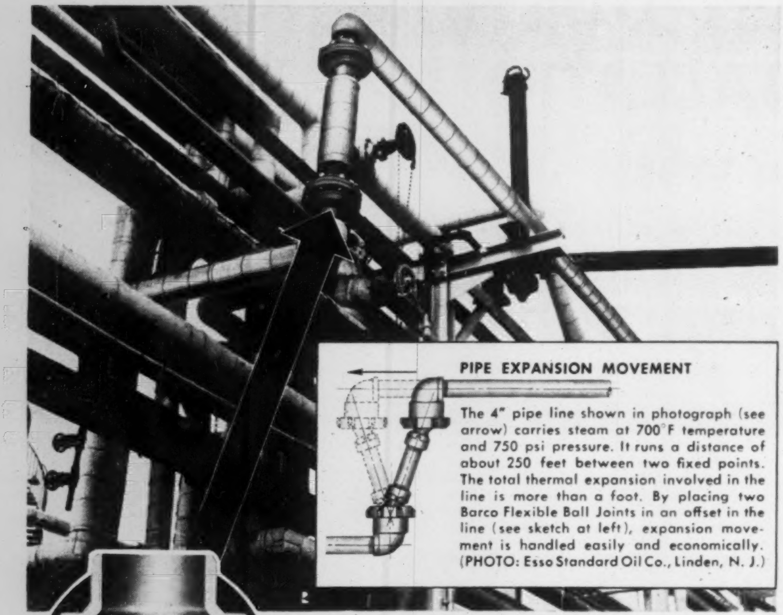
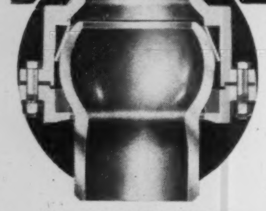
How Plant Handles 700°F. STEAM . . . PIPE EXPANSION



PIPE EXPANSION MOVEMENT

The 4" pipe line shown in photograph (see arrow) carries steam at 700°F temperature and 750 psi pressure. It runs a distance of about 250 feet between two fixed points. The total thermal expansion involved in the line is more than a foot. By placing two Barco Flexible Ball Joints in an offset in the line (see sketch at left), expansion movement is handled easily and economically. (PHOTO: Esso Standard Oil Co., Linden, N. J.)



BARCO HT HIGH TEMP. Flexible BALL JOINTS

SAVE VALUABLE SPACE

ADVANTAGES:

SAVE SPACE — Barco Ball Joints are used to perform functions similar to U-bends or pipe loops — But with much less space required and often LOWER COST.

NO PRESSURE THRUST — Expensive anchoring or bracing not required to hold piping in place or in line.

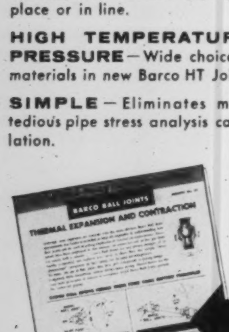
HIGH TEMPERATURE, PRESSURE — Wide choice of materials in new Barco HT Joints.

SIMPLE — Eliminates much tedious pipe stress analysis calculation.

The Barco HT (High Temperature) Flexible Ball Joint is a new development. It is *the key* to solving many PIPE EXPANSION PROBLEMS where high temperatures and pressures are encountered. HT joints can be supplied in sizes from 2" to 16", angle or straight, and can be fabricated from materials to withstand as much as 1000°F, 1200°F, or even 1400°F, under certain conditions.

Rugged "Fire-Safe" Barco joints have no thin wall sections, no critical points of fatigue, no rubber seals. They develop no "end thrust". . . *no reactive forces;* require no expensive anchoring. They are ideal for steam and all kinds of fluids.

Local Barco Field Engineers will be glad to give you full information and recommendations. Call or write today.



Send for this BULLETIN 31

"How To Use Barco Expansion Joints". Complete with piping layout drawings and illustrations. Shows how to cut costs, save time, and do a better job!

PRODUCTS BACKED BY EXPERIENCE BARCO FOUNDED 1908

BARCO MANUFACTURING CO.
541F Hough Street • Barrington, Illinois

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Rotary Joints
In Canada: The Holden Co., Ltd., Montreal

EQUIPMENT DEVELOPMENTS

Continued

Steam-Mixer Water Heater Available as Packaged Unit

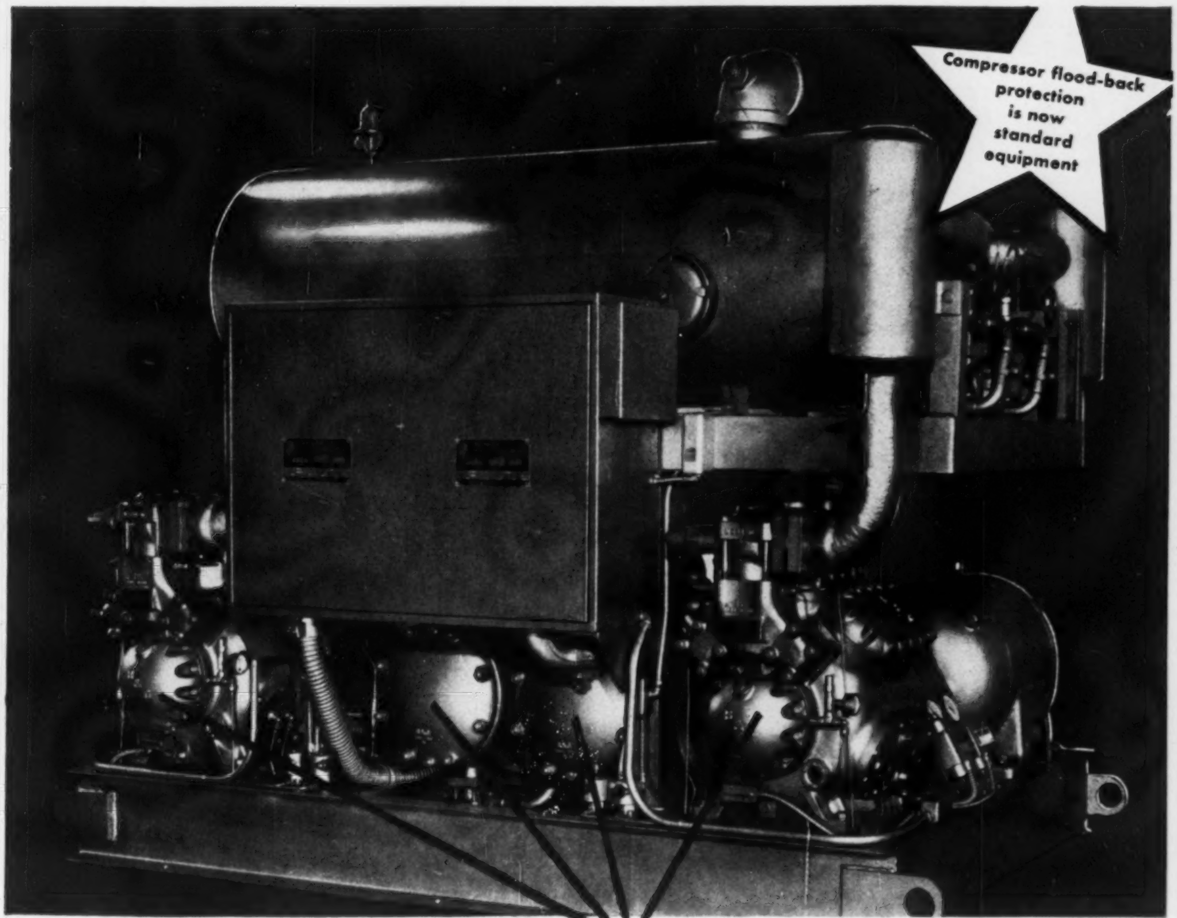
Packaged automatic steam-mixer water heater has capacities from 10 to 100 gpm at 50 to 125 psi steam. Models available with higher pressures. Consists of all cast bronze body with double-sleeve bronze diffuser. Packless temperature regulator with stainless steel trimmed valve, single or double seated. Has ASME automatic temperature-pressure relief valve, poppet check valves, and a combination water pressure regulator and strainer. Available for single or multiple water temperatures. — *O'Brien Steam Specialty Co., Inc., P.O. Box 217, Eastwood Station, Syracuse 6, N.Y.*

Axial Flow Fans Rated Up To 15,000 Cfm

A modular system of polyester blades gripped in various sizes of aluminum alloy hub afford 72 different impellers, from 12 to 28 in. rated up to 15,000 cfm. Unit has airfoil profile, is non-sparking. — *Mainstream Co., 1323 First St., Coronado, Calif.*

Gas Fired Make-Up Air Units Have Dual Fans

Horizontal dual-fan direct-gas-fired make-up air units in nine sizes. Capacities range from 20,000 to 60,000 cfm with from 1,875,000 to 6,000,000 Btu per hr. Each unit designed to maintain a constant discharge temperature of 80 F throughout a range of outside temperatures from −15 to 80 F. Controls are automatic. — *Metals Engineering & Manufacturing Co., Inc., 8824 Lyndon, Detroit 38.*



NOW 2 COMPLETE CIRCUITS IN ONE COOLER

Another example of B&G creative engineering!

The B&G Package Liquid Cooler is now available *with two complete refrigeration circuits*...dual compressors, dual condensers and a single evaporator! It has a capacity reduction to 25%—in stages of 100, 75, 50 and 25%. All operative and safety controls are installed and pre-wired.

An outstanding feature is the automatic lead-lag selector switch. In operation, No. 1 motor and compressor handle the load until cooling requirements are satisfied or until No. 2 unit needs to be called into use.

On the next starting, No. 2 unit picks up the load. Therefore each motor and compressor gets equal usage. This dual arrangement is also valuable because it provides stand-by protection in case of emergencies.

Remember, too, that all major parts of B&G "package" units are manufactured and guaranteed by Bell & Gossett Company...*one* responsibility for satisfactory operation.

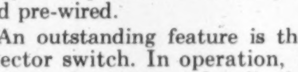
Send for complete specification and application data on B&G Air Conditioning and Refrigeration equipment.

BELL & GOSSETT COMPANY

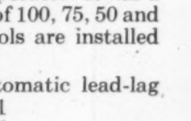
Dept. RGQ-5, Morton Grove, Illinois

Canadian licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

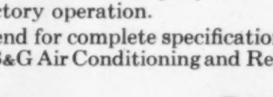
A FULL LINE OF REFRIGERATION AND AIR CONDITIONING "PACKAGES" AND COMPONENTS



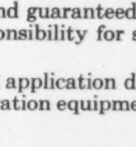
B&G Evaporator



B&G Centrifugal Pump



B&G Condenser



B&G Condensing Unit

from "Chicago"

immersi-pump

Trademark

SUBMERSIBLE NON-CLOG SEWAGE AND SUMP PUMP

Positively water proof—motor is totally enclosed and oil filled.

- Pumps Sewage and other Liquids Containing Solids up to 2½″
- Operates with pump and motor completely submerged

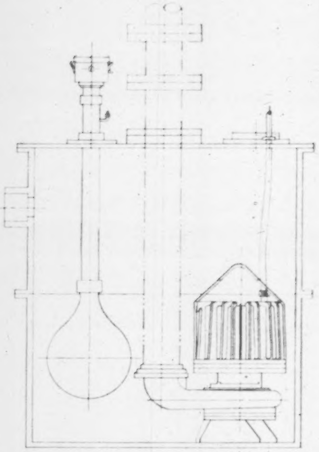
Check these SEVEN important features

1. Low original cost
2. Low maintenance cost
3. Easy to install
4. Easy to service
5. No superstructures required
6. Minimum headroom needed
7. Makes more floor space available

PLUS

Exclusive SEALTRODE Sealed Electrode Floatless Pump Controller . . . the only controller featuring completely sealed Electrodes . . . positively preventing insulation or coating by grease or other corrosive elements.

Ask for Bulletins Nos. 97 and 128-A.



Typical installation—single unit—duplex installation available

"Chicago" Distributors are located in most principal cities. See the one nearest you today for full details.

Putting Ideas to Work

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

FOOD MACHINERY AND CHEMICAL CORPORATION
HYDRODYNAMICS DIVISION
CHICAGO PUMP
622C DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

EQUIPMENT DEVELOPMENTS

(Continued)

Portable Psychrometer Gives Rapid Humidity Readings

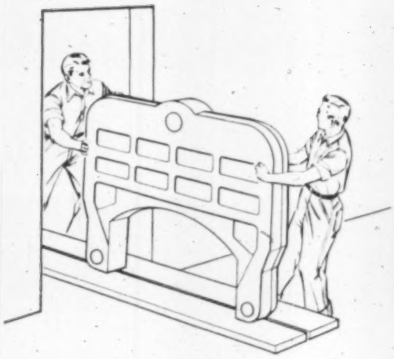
Portable unit gives precise wet bulb and dry bulb readings for determining relative humidity, absolute humidity, dew point, or enthalpy in air and other gases. Indication usually obtained within 10 sec. Uses tiny thermistor beads as resistance thermometer elements. Temperature indicated directly on three overlapping scales of the meter in increments of ½ F or 0.2 C. Accuracy better than 0.5 percent over most of scale. System powered by standard mercury batteries. Can be used in bases between 10 and 176 F.—*Atkins Technical, Inc.*, 1276 *W. Third St., Cleveland* 13.

Float Air Eliminator Has Flush Cleaning Feature

Unit for use on hydronic heating systems and chilled water cooling systems. Sediment, scale, and scum flushed out of valve with system's own pressure. Has heavy non-corrosive brass and copper construction with a non-magnetic stainless steel needle stem. —*Sure-Flow Corp.*, 5249 *Kings Highway, Brooklyn* 34.

Rubber Expansion Joint For Flexible Connector

Endless belt-type rubber expansion joint for use as large circumferential flexible connector in duct systems and similar applications. Units molded of duck and rubber with rope-core beads integrally formed on each side of the web of the expansion joint. Has an overall width of 9⅜ in. with a web thickness of ⅝ in. and a bead thickness of 1¼ in. Maximum operating pressure is 15 psi or up to 30 in. Hg vacuum. Maximum working temperature is 180 F. — *General Rubber Corp., 66 Summit St., Tenafly, N. J.*



HOW TO PASS MILLIONS OF BTU THROUGH AN ORDINARY DOOR

You can do it easily with a Weil-McLain *sectional* cast iron boiler!

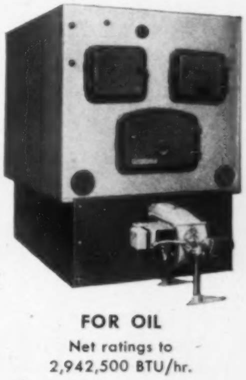
Any Weil-McLain boiler, no matter what its capacity, can be passed through an ordinary door, *section by section!*

In existing buildings, additional sections can be installed if extra capacity is needed (or an additional boiler), without structural changes. In new buildings, construction need not wait for boiler installation; the boiler can be installed after the job is under roof.

Sectional Weil-McLain boilers offer these additional *plus* values... less boiler room space needed... built of corrosion-resistant cast iron ...strain-free assembly with short draw rods... tested and rated by I=B=R...easy maintenance and long life.

Weil-McLain Cast Iron Sectional Boilers for commercial and industrial installations are available for gas, oil, heavy oil, combination gas—light oil or coal. For full information write Weil-McLain Company, Michigan City, Indiana, or see Engineers' Product File or Sweet's Architectural File for current oil boiler data.

FOR GAS...
Net ratings to
3,354,000 BTU/hr.

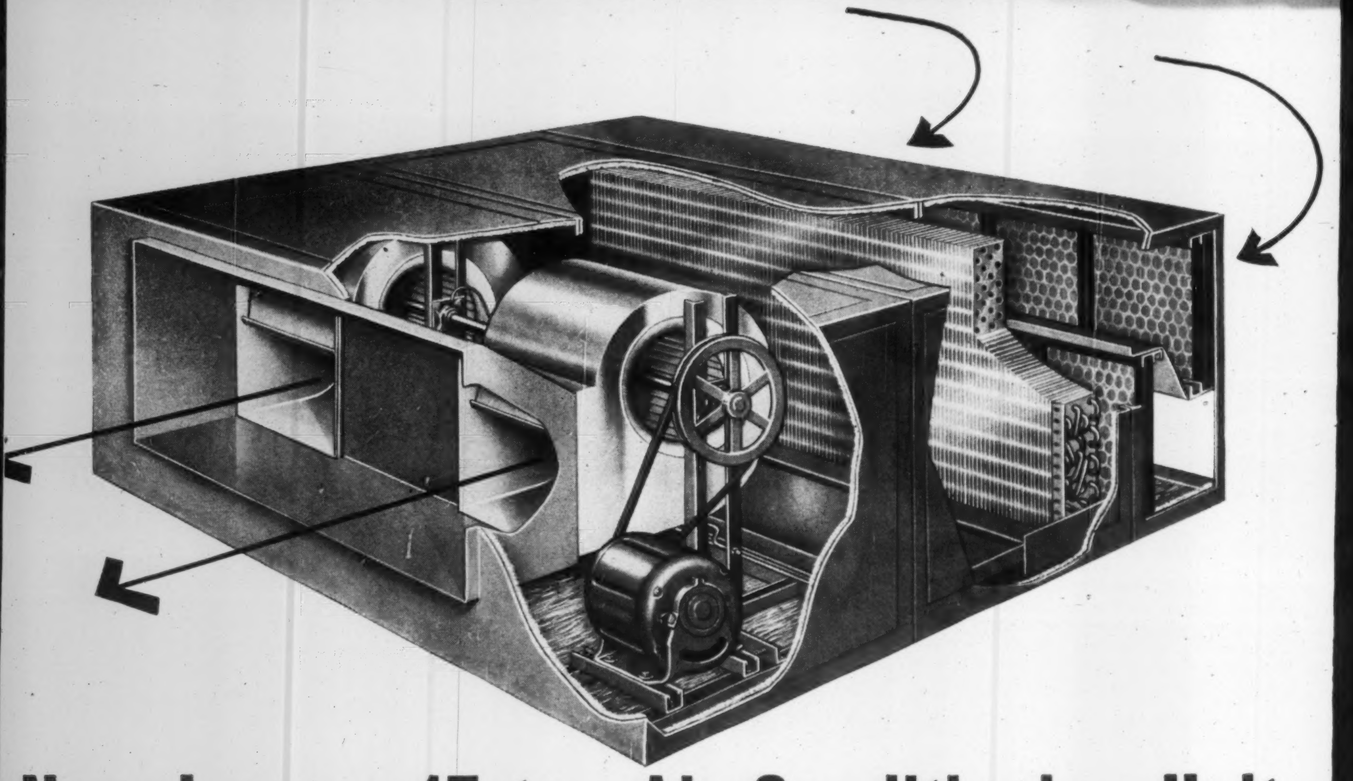


FOR OIL
Net ratings to
2,942,500 BTU/hr.

WEIL-McLAIN

CAST IRON BOILERS

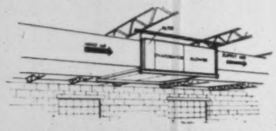
WEIL-McLAIN COMPANY, INC. • DEPT. AA-51 • MICHIGAN CITY, INDIANA



New Lennox 17-ton Air Conditioning Unit

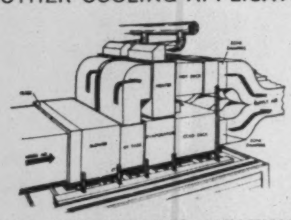
EASILY ADAPTS TO WARM AIR HEATING

. . . room in cabinet for hot water
or steam coils

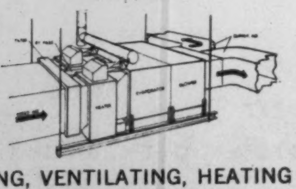


COOLING SYSTEM ONLY
(or with wet heat coil added)

ANOTHER COOLING APPLICATION



COOLING, VENTILATING, HEATING WITH
DIRECT-FIRED HEATER
(multi-zone)



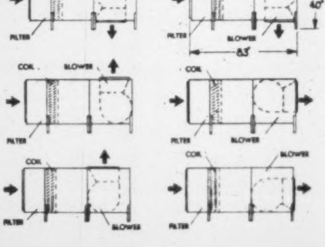
COOLING, VENTILATING, HEATING WITH
DIRECT-FIRED HEATER
(single-zone)

A "jillion" possibilities for up-flow, down-flow or horizontal application

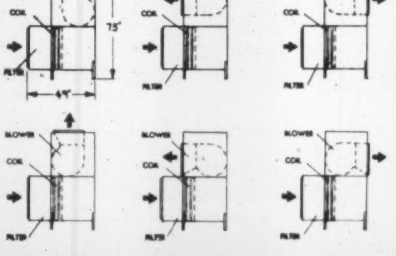
You've asked for it and here it is! Never before has so much cooling been put in such a compact package. And, a unique dual refrigerant circuit gives you latent capacity control without using expensive by-pass ducts or complicated control systems. A simple two-stage controller does the job, providing modulated temperature and humidity control. The ample face area of the coil reduces total resistance in the system. Result: lower BHP.

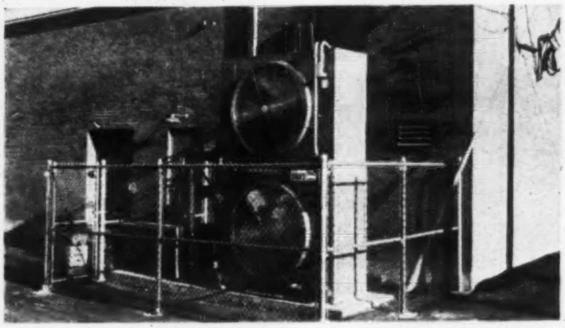
The unit consists of three sections: evaporator, blower, and filter. They are easily assembled for horizontal, up or down air delivery. Motor and plumbing are enclosed in the cabinet which is weatherproof and lined with 1-inch fiberglass. Recessed blower outlets permit duct connection without additional transitions. All servicing can be handled from one side. For complete data, write LENNOX, 619 S. 12th Ave., Marshalltown, Iowa.

HORIZONTAL MOUNTINGS



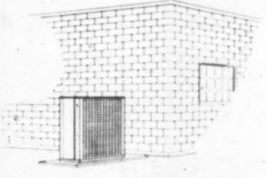
VERTICAL MOUNTINGS



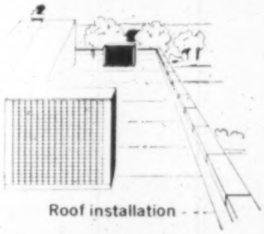


Lennox Air-Cooled Condensing Unit for Commercial and Industrial Use

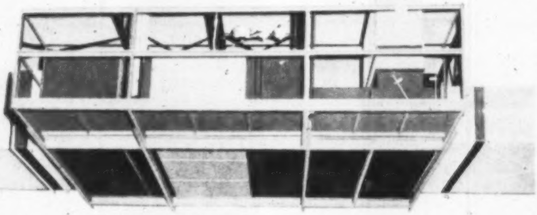
Here's economy, ruggedness and application ease all in one unit. Exclusive circuiting method subcools the refrigerant so it reaches the evaporator much cooler than in average units; sub-cooling increases this unit capacity by 10%. Result: over 10 Btuh cooling per watt of total input (85° outdoor air). Straight-through air travel permits "stacking" of units, as in photo above.



Unit at grade level on slab



Roof installation



You can heat, cool or ventilate any existing building with Lennox equipment

The complete line of Lennox equipment, and your Lennox representative will make your designing and buying job easier . . . providing one central source for direct-fired heaters with up to 2,000,000 Btuh capacity, and cooling and ventilating for any job.

Don't be satisfied with less than

LENNOX

Heats • Cools • Treats and Moves Air

IN HOMES IN CHURCHES IN SCHOOLS IN BUSINESS IN INDUSTRY

LENNOX INDUSTRIES INC., FOUNDED 1895 — MARSHALLTOWN AND DES MOINES, IOWA; COLUMBUS, OHIO; SYRACUSE, NEW YORK; DECATUR, GEORGIA; FT. WORTH, TEXAS; SALT LAKE CITY, UTAH; LOS ANGELES, CALIFORNIA. LENNOX INDUSTRIES (CANADA) LTD — TORONTO, MONTREAL, CALGARY, VANCOUVER, WINNIPEG.

Pilot-Loaded Regulator Package Provides Extended Capacity Range

Package combines a cast iron "173" high pressure regulator assembly and standard diaphragm with an "080R" pilot. Unit has an operating range of 10 to 100 psi water gage inlet pressure, 2 to 20 psi WG outlet pressure. Capacity ranges from 2000 to 15,000 cfh of 0.6 gas, dependent upon pressure and orifice size combinations. Available in 1 × 1 in. standard and ¾ × ¾ in. optional connection sizes. Standard orifice size is ¼ in. with optional orifice sizes of 3/16, ⅜, and ½ in. Information sent on request. — *Rockwell Manufacturing Co., Meter and Valve Div.,* 390 *N. Lexington Ave., Pittsburgh* 8.

Bimetal Disc Thermostat For Service to 350 F

Snap-acting thermostat is UL listed for accurate repeatability over 100,000 cycles at temperatures up to 350 F for 10 amps at 120/240 v a-c. Enclosed or exposed bimetal disc and various mounting flanges and terminal arrangements available. Bulletin 46 sent on request. — *Therm-O-Disc, Inc., Mansfield, O.*

Centralized Lubrication Systems For Heavy Industrial Equipment

Units for gas and process compressors and other heavy industrial equipment, including turbines and pumps. "Meter-Pak" features individually adjusted valves for delivery of from 0.003 to 0.015 cu in. of oil each time system is cycled. Accuracy of delivery within ±5 percent over all ranges of volume and pressure settings. Pressure ranges from 100 to 7000 psi. Pneumatic or electric signalling devices indicate positive delivery of lubricant for control of remote equipment. — *Stewart-Warner Corp.,* 1826 *Diversey Pkwy., Chicago* 14.

Finned Tubular Electric Heating Elements for Convection, Forced Circulation Applications

Units for use with fan heaters, blower coils, and convection baseboard. Rated up to 350 w per ft in convection and 1000 w per ft in forced circulation. Available in continuous lengths of up to 12 ft. Copper-hydrogen brazed steel fins spaced according to specification; three and a half fins per running in. are standard. Available for voltages to 277 v or higher. — *Still-Man Manufacturing Corp.,* 429 *E. 164th St., New York* 56.

NEW!

FROM THE HOT HAMMERS AT

BONNEY

THE WORLD'S FINEST

FORGED STEEL FITTINGS

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for all services

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Forged Steel Fitting Catalog

BONNEY FORGE AND TOOL WORKS
ALLENTOWN, PENNSYLVANIA

EQUIPMENT DEVELOPMENTS

Continued

Direct Contact Electric Heaters For Heating Gases

Direct contact electric resistance heaters for processes involving air, nitrogen, hydrogen, argon, helium, and natural gas. Applications include regeneration of desiccants, ammonia synthesis, gas preheaters for atomic reactors, high temperature processing, and similar uses. Design and unit arrangement of "Radi-Fin" heater depends on its specific application. Basic construction pattern is nickel chrome ribbon formed into a "V" shape. Current applications involve temperatures up to 1800 F. At least one application involves pressures of 4500 psi. — *Hynes Electric Heating Co., 1063 U.S. Route 22, Mountainside, N.J.*

Cooling Water Treatment Available in Packaged Form

Cooling water treatment for small cooling towers, evaporative condensers, and cooling water systems available in packaged form. Treatment controls pH factor, acid feed rate, and corrosion. Includes polyphosphates, chromates, and algicides. Information sent on request. — *L*A Water Conditioning, Inc., 1007 Air Way, Glendale, Calif.*

Polypropylene Filter Fabrics Have Combination of Yarn Types

Combination multifilament - spun staple fabrics constructed in plain and twill weave variations for dust collection and other applications. Suited to hot, corrosive applications involving the separation of gelatinous precipitates and fine or abrasive dusts. Available as fabricated elements or as yard goods. — *Technical Fabricators, Inc., 136 Washington Ave., Nutley, N.J.*

Motor Starters Available in Seven Sizes to 200 Hp, 440-550V

Across-the-line solenoid starters available in seven sizes with maximum ratings from 1½ hp. 220 v; 2 hp. 440-550 v; up through 100 hp. 220 v; 200 hp. 440-550 v. Line has NEMA Type enclosures. Employs "one moving part" solenoid principle. Features double break contacts of cadmium oxide silver that resists welding. Has totally enclosed arc chambers that confine the arc, limiting ionization and the resulting heat. Bulletin 709 sent on request. — *Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4.*

Three-Way Solenoid Valves Explosion-Proof

Units with ½ in. main orifice and ½ in. NPTF available normally open, normally closed, and directional control, with operating pressure differentials of 5 to 150 psi. A ½ in. conduit housing is standard with valves. Units have naval forged brass bodies and internal parts of brass and stainless steel. Available in wide range of voltages and frequencies. Information sent on request. — *Skinner Precision Industries, Inc., Skinner Electric Valve Div., New Britain, Conn.*

Pump Motor for Standard, Medium, And Heavy Thrust Applications

Vertical hollow-shaft units rated from 1 through 30 hp in frame sizes 225 through 326U. Vertical solid-shaft motors rated from 1 through 60 hp, in frame sizes 182 through 365U. All windings impregnated with a special varnish and permanently cemented into a single solid mass by a double-immersion and baking process for weather protection. Available in drip proof or totally enclosed types; hollow-shaft, solid-shaft, or close-coupled models. — *Reuland Electric Co., Alhambra, Calif.*

Foamed Plastic Insulation for Pipe Available in Tube or Sheet Form

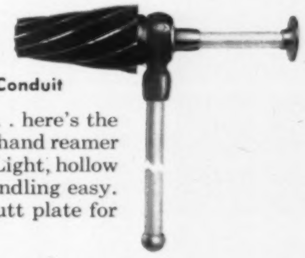
Insulation for liquid cooling and heating lines from sub-zero to 220 F. "K" value is 0.28 at 75 F; water vapor tranmission rating is less than 0.1 perm; fire rating is "self-extinguishing." Tube available in 6 ft lengths, diameters from ⅜ to 3½ in., and in three wall thicknesses. Sheet measures 30 × 36 in., in thicknesses from ⅛ to ¾ in. — *Gustin-Bacon Manufacturing Co., 210 W. 10th St., Kansas City, Mo.*

World's Fastest, Smoothest Hand Reaming

1/8" to 2" Capacity
Self-Feeding
RIDGID
No. 2-S
Spiral
Reamer
...reams pipe,
conduit,
sheet metal
and wood!

Try a RIDGID Spiral Reamer, and you'll quickly feel how it reams its way into pipe, conduit, metal holes or wood without effort. Heat-treated cutting edges give maximum service life. Ratchet-action handle makes work easy in close quarters.

Now Available . . .
RIDGID No. 254
Spiral Reamer
for 2½" to 4" Pipe and Conduit



No more hand filing . . . here's the time-saving, large-size hand reamer you've always needed. Light, hollow construction makes handling easy. Hand grip has large butt plate for body pressure.

Call your Distributor today. For your convenience, he maintains a complete stock of RIDGID Work-Saver Pipe Tools and parts!

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THIS UNIT HAS BEEN CERTIFIED AS COMPLYING WITH
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ARI STANDARD 210

Thank you, 74%

Good news! When we surveyed air-conditioning dealers in 21 cities last summer, we found that 74% knew of our Certification program. More important: 6 out of 10 familiar with the program *use it in their selling.*

Thus, in less than two years, air-conditioning dealers have demonstrated their enthusiasm for ARI certification. Many have thought up ingenious ways to sell with the program—and we're delighted.

But we won't rest on our laurels. Dealers kept telling us they'd like a sales piece that would explain the ARI Certification program to their customers, so we designed "How to Buy Central Air-Conditioning." It tells consumers the whys and hows of air conditioning, outlines the Certification program, suggests why air conditioning should not be bought on the basis of price alone. For a sample copy, write (on your letterhead, please) ARI.

how to buy central air conditioning

AIR CONDITIONING AND REFRIGERATION INSTITUTE

Department H-512, 1346 Connecticut Ave.,
N.W., Washington, D.C.

Control Valves Available in Cast and Stainless Steel

Control valves for chemical, steam, air, water, oil, and gas service available in cast steel or stainless steel bodies. All stainless steel trim is standard. Self-operated or controller-operated models for 300 psi and 500 F WSP service. Bulletin JNP-7 sent on request. — *OPW-Jordan,* 6013 *Wiehe Rd., Cincinnati* 13.

Electronic Controller Operates Up To 12 Process Valves

Unit provides automatic operation and timing of up to 12 valves in sequence. For use in conjunction with firm's No. "1825" electric remote control valves. Individual timing wheels actuate valves; valves may be set to flow from 3 to 60 min on individual cycles. Separate on-off switches permit any valve cycle to be shut down without affecting others. Omitting wheel permits scheduling of up to 14 days and will repeat this schedule unless reset. Unit also available for controlling six valves. — *Febco, Inc.,* 1993 *Blake Ave., Los Angeles* 39.

Automatic Relief Valve Operates Between 200 and 210F

Unit for temperature-pressure protection of hot water tanks and heaters. Meets standards of AGA, ASA, and FHA. Operates between 200 and 210 F, automatically resetting when conditions return to normal. Features heavy red brass body, test lever, stainless steel control spring, 6 in. exposed extension tube, and special bibb washer. "503" has 3/4 in. inlet and outlet. Standard pressure setting is 125 psi with other settings available. Rated at 80,000 Btu per hr steam. — *Mansfield Sanitary, Inc., Perrysville, O.*

Calking Gun Features Built-In Cut-Off Knife

Gun for use with firm's calking compound. Has knife in handle for cutting plastic nozzle of compound's container. Four sizes of calking bead can be made. — *Macklanburg-Duncan Co., P.O. Box* 1197, *Oklahoma City* 1, *Okla.*

Plastic Drainage Fittings For Bituminized Fiber Pipe

Fittings for use with firm's bituminized fiber pipe. Available in 4 in. adapters, Y's, T's, 1/8 and 1/4 in. bends. Units have smooth interior for unrestricted flow. — *Sonoco Products Co., Hartsville, S.C.*

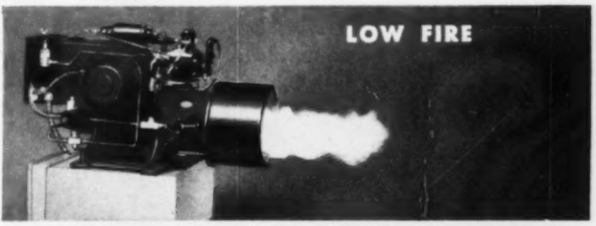
Continued on page 216

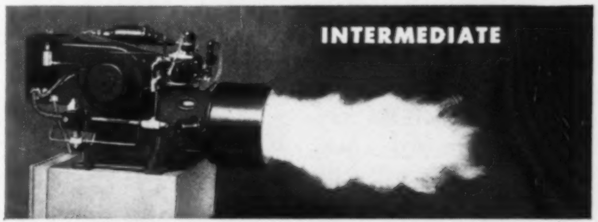
Burner does a slow burn

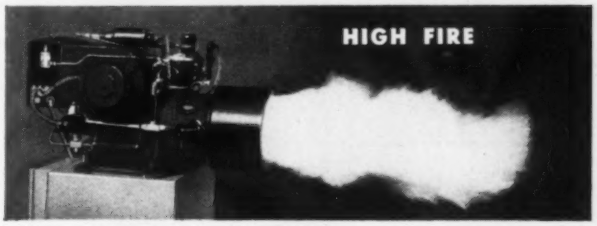
for smooth, economical operation

HEV-E-OIL BURNERS start with a low fire, a small flame which gradually builds up to the required size for safe, smooth operation. Low fire and high fire are controlled exactly to assure top efficiency over the entire firing range. Moreover, Hev-E-Oil burners furnish all the primary and secondary air needed for efficient combustion. Available from 5 to 150 gph. Also combination gas/oil burners from 720,000 to 21,000,000 Btu.

HEV-E-DUTY POWER GAS BURNERS also utilize slow fire build-up for top performance. Air is metered in correct proportion to the amount of gas being used, resulting in high efficiency regardless of chimney draft caused by outside weather conditions. Sizes from 720,000 to 21,000,000 Btu. For more information on Hev-E-Duty Power Gas, Hev-E-Oil and combination burners, write Dept. HPA-41.







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INC.
EXECUTIVE OFFICE: 4507 N. OAKLAND AVENUE
MILWAUKEE 11, WISCONSIN

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with
Fiberglass Housings*
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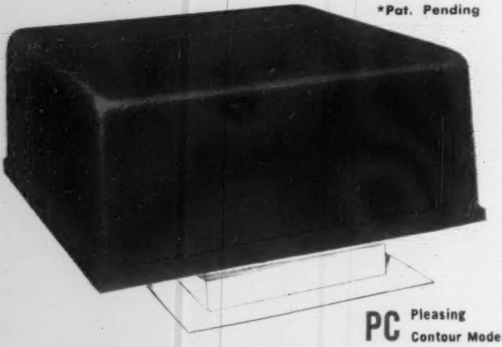

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COAL —

what every engineer should know

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By WILLIE HAMMER
Mechanical Engineer

Q. What is coke? Where is it used?

A. Coke is the residue, consisting principally of fixed carbon, left after coal has been heated to drive off the volatile matter. This is known as carbonization. Its major uses are in metallurgical industries where carbon is required for the reduction of ores, in areas where smokeless fuel is required, for domestic heating, and for production of combustible gases.

Q. How is coal processed into coke?

A. Bituminous coal is heated in the absence of air until the moisture and almost all the volatile matter are removed. During the process, the coal becomes plastic and swells. With the loss of the volatile matter, the remaining material, coke, becomes porous and then hardens. The temperature at which the coal is processed determines the class of coke, which is listed as high, low, or medium temperature. Almost all of the coke produced in the U. S. is high-temperature and the very small balance low temperature. There is practically no medium temperature coke produced.

Q. What are the reasons for these limitations?

A. Low volatile coals expand and form low density coke, necessitating, in its ultimate use, a greater volume to supply the same weight of carbon. Coals which expand substantially on heating may injure the coke oven walls. Very high volatile coals form coke with little strength and which breaks up into fines. The presence of ash also reduces the amount of combustible present in the final product, necessitating greater volume for any certain weight of carbon. There is no lower desirable limit to the amount of ash. Sulfur and phosphorous are both deleterious materials which would adversely affect the properties of the materials being processed. Excessive moisture in coke will form steam which will injure the linings of the processing furnaces in which combustion later takes place.

Q. What is "blending" of coal for coking?

A. Some types of coal have certain disadvantages which can be alleviated by mixing or blending with other coal: High and low volatile coals are mixed; coals which expand excessively under heat are mixed with types which contract under the same conditions; and coals with different caking tendencies are mixed to give the desired end results.

Q. What is the availability of good coking coal?

A. Almost all (96 percent) of the coking coal in the U. S. comes from the Appalachian area, extending from Pennsylvania to Alabama, with West Virginia and Pennsylvania together furnishing over 70 percent of the total shipped each year. Utah and Colorado furnish 2 percent of the national total.

Q. What are the temperatures of the three coking processes? What are the advantages of each?

A. High temperature coke is processed between 1800 and 2100 F; low temperature, below 1400 F; medium temperature, 1400 to 1800 F. High temperature coke is hard and dense, has very little volatile matter (up to 3 percent) and is hard to ignite. High temperature methods yield more gas and less tars than do the other processes and the resulting coke is more suitable for use in metallurgical processes. Low temperature coke is porous and breaks easily, contains more volatile matter (7 to 15 percent), and is easier to ignite. More tars and less gas are derived from this process. The low temperature process requires larger ovens for the same weight of coke produced. Medium temperature coke has intermediate characteristics, advantages, and disadvantages and is little used.

Q. Since volatile matter will distill off at temperatures under 1300 F, why are higher temperatures used to produce coke?

A. Lower temperatures require prolonged heating which necessitate excessive process time, and undesirable residues are left. Use of higher temperatures increases the production rate, increases the tendency to cake, decomposition of hydrocarbons is less, the volume and total heat in the gas produced are increased even though the heating value per cubic foot

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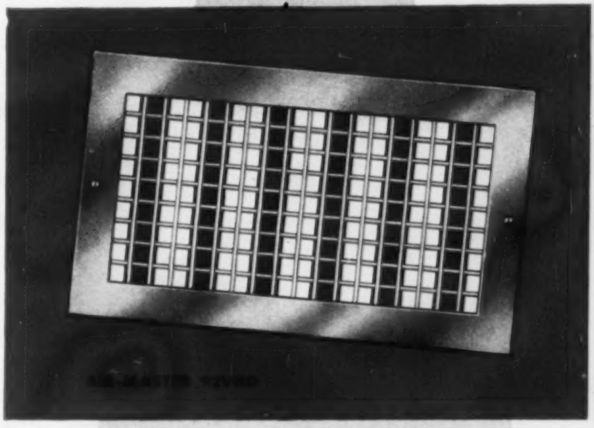

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COAL —

what every engineer should know

Continued

of gas decreases (due to the decrease in amounts of tar and ammonia produced).

Q. What other materials are obtained when coke is produced in a byproduct oven?

A. Crude tar; ammonia; light oils giving benzene, toluene, xylene, and naphtha; and coke oven gases consisting of carbon dioxide, carbon monoxide, methane, ethylene, nitrogen, hydrogen sulfide, and cyanogen. The percentages of each item depend on the type of coal used, the type of oven and coking temperature, and the method used to recover the byproducts.

Q. How much coal is required to produce a ton of coke? How much coke is required in the production of pig iron?

A. About 1.4 tons of coal is required to produce a ton of coke. One ton of coke will be used in the production of 1.1 tons of pig iron. In 1957, about 66 million tons of coke were used for this purpose.

Q. What is coke breeze?

A. Breeze is the name given to the fines produced in the manufacture of coke. It will pass through a 3/4 in. round hole screen.

Q. What are the different types of ovens used to produce coke?

A. Slot type, beehive, and sole heated ovens, and horizontal, inclined, and vertical retorts. There are approximately twice as many slot type ovens as there are beehive type. Slot type ovens produce over 96 percent of the coke in the U. S.

Q. What type of oven is used to produce byproducts in addition to coke?

A. Slot type ovens, usually of the vertical type, are normally used. *Beehive* ovens, in most cases, are not designed to permit recovery of volatile matter but are used only to produce coke for metallurgical processes.

Q. What is "gashouse coke"?

A. Gashouse coke is a byproduct from the manufacture of "city" gas, usually produced in vertical or horizontal retorts. In this process, the production of gas from coal is the prime purpose and the characteristics and quality of the resultant coke are somewhat variable. Because of the greatly increased use of nat-

Continued on page 208

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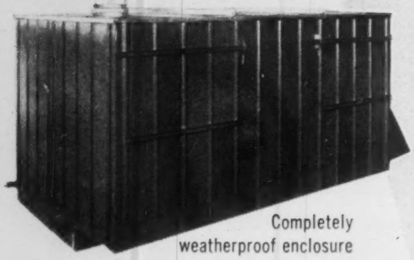

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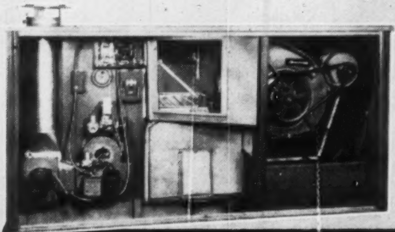

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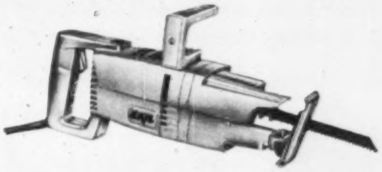

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COAL—

what every engineer should know

Continued

ural gas, the production of city gas and of gashouse coke has decreased substantially during the past few years. However, there are still about 80 plants in the U. S. producing city gas. The amount of coke produced for sale is about 1 percent of the national total.

Q. About how much coke will a modern oven produce? How much coke is produced yearly in the U. S.?

A. Modern slot type ovens will hold about 20 tons of coal per charge, resulting in about 15 tons of coke. The rate of production is about 0.7 ton of coke per hour. Beehive type ovens produced about 2 million tons of coke per year; all other types, mostly slot type ovens, produced about 73 million tons. Total value of coke produced was about $1.3 billion.

Q. Can the amount of coke which will result from the carbonization of a pound of coal be predicted from the coal analysis?

A. Since the type of process and the temperature used will affect the amount and composition of the coke produced, only very general predictions can be made without knowing the detailed factors involved. However, one general formula sometimes used is: Percent of dry coke = 19 + 0.79 × (percent of fixed carbon + percent of ash in coal).

Q. What is underground gasification?

A. The production of combustible gas by burning coal in underground beds by forcing air, oxygen or steam into the seams. When air is used, the resultant gas has about 100 Btu per cu ft; with oxygen, 200 Btu; and with steam, 300 Btu. In this process, coal used is uneconomically removable by present methods. Also, it is unnecessary that the original coal be of the caking type. The gas generated is used at plants in the vicinity producing power, process steam or heat.

Q. Is this process used to any great extent?

A. In the U. S. it is still in the experimental stage with series of tests being made at a mine in Alabama. In Russia, a large scale program is underway to use this method to produce gas with a heating value of 133 Btu per cu ft. Underground gasification is also being used increasingly in Great Britain.

Q. What is coal char?

A. Lignite and subbituminous coal are not suitable

Continued on page 210

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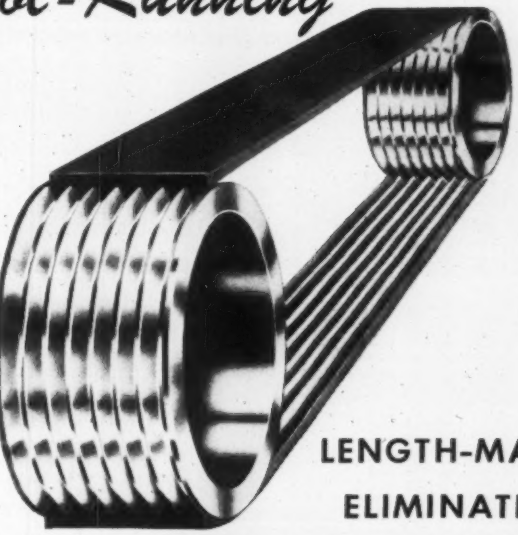

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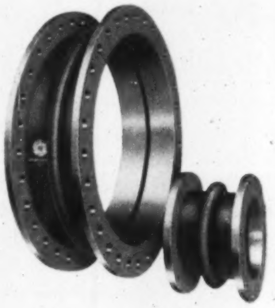

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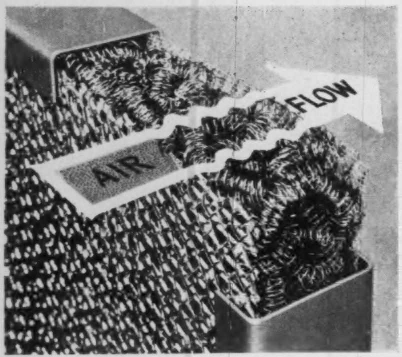

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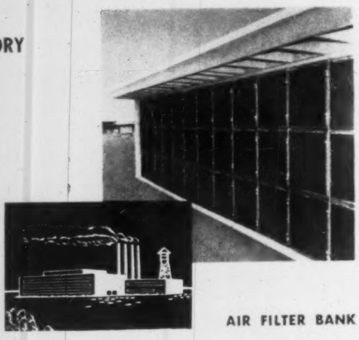

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COAL —

what every engineer should know

Continued

for production of coke because of their non-agglomerating character. However, processes have been carried out in which these coals are carbonized at low temperatures to produce a dry, powdery material called *char* which can be burned either in pulverized equipment or after it has been formed into briquets.

Q. What are colloidal fuels?

A. Mixtures of finely ground coal (approximately 40 percent by weight) suspended in oil. Such mixtures permit use of coal of very fine sizes or of low quality, permit reduction in transportation and storage costs, can be burned with steam atomizing equipment, and have a higher heating value per unit of volume than oil or coal alone.

Q. What is "coal slurry"?

A. A mixture of very fine coal and water. Maximum amount of coal in the mixture has been found to be about 50 percent after which it begins to settle out. It is now being used in one large application to supply coal to a power generating plant through a pipeline over 100 miles long. The coal is pulverized at the mine, mixed with water, and pumped to the generating plant where it is dewatered and used as a fuel. The result is a very substantial savings in transportation cost (about $1 per ton at present rates).

Q. What percentage of the total delivered cost of coal is for transportation and handling to the plant?

A. On the average, rail transportation increases the cost of coal by about 70 percent of its cost at the mine. Rail transportation still constitutes the method by which most of the coal is delivered, but during the past five years the amount moved by this method has decreased slightly as companies have made efforts to reduce delivered costs. A number of power generating plants have been, or are being, built near coal fields; near bodies of water over which the coal can be transported comparatively cheaply; with highly mechanized rapid unloading equipment which permit reductions in transportation and handling charges; or by scheduling deliveries so that receipts are approximately equal to usage in order that handling and storage may be minimized.

Q. What is petroleum coke?

A. The residue left after the distillation of oil. It consists mostly of pure carbon with small amounts of

Continued on page 212

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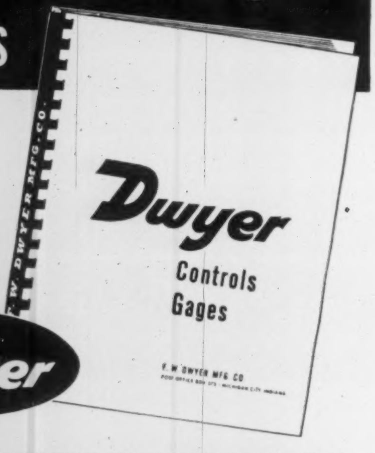

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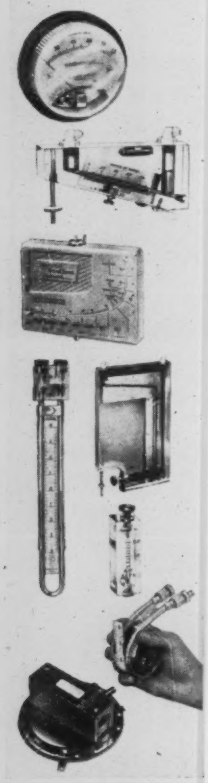

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COAL —

what every engineer should know

Continued

ash and sulfur. It can be burned on grates, usually mixed with other solid fuels. Its composition varies considerably, depending on the source of the oil, the type of equipment, and the temperature and type of process in which it is produced.

Q. At what temperatures do coal and coke ignite?

A. Lignite — 435 F; low-volatile bituminous — 870 F; high-volatile bituminous — 765 F; anthracite — 925 F; coke — 900 F. Carbon monoxide in a fuel bed will ignite at approximately 1290 F.

Q. How does coal burn?

A. In order to burn, the combustible constituents of coal must be in gaseous form. The volatile matter is given off as gas as the coal is heated. The carbon at the surface of the coal atomizes under the action of heat and oxygen and forms carbon monoxide and dioxide. When sufficient oxygen becomes available, the carbon monoxide and volatile matter burn producing additional heat. As the carbon on the surface of the coal turns to gas, additional surfaces are exposed and more volatile matter released, continuing the combustion process. The ease with which the coal burns depends on the rapidity with which it becomes gas.

Q. Does this mean that, if more coal surface is exposed to oxygen, combustion will be more rapid?

A. Yes. This is the principle behind pulverized burning of coal. This is also known as suspension firing. In this case, the coal is ground fine and blown through a burner (similar to those used for oil or gas) into a furnace where it is mixed with additional air. Because of the comparatively large surface area of each particle exposed to air and oxygen and to the high furnace temperatures, gasification of the carbon and combustion is almost instantaneous.

Q. How fine is the coal ground before it is used in a pulverized furnace?

A. The fineness to which coal is ground depends on many factors: the characteristics of the coal, burner and furnace design, length of flame, and furnace temperature. Small furnaces, low volatile coals, and caking coals generally require finer grinding than their opposites — small furnaces because there is usually less time in which the coal may ignite and burn; low volatile coals because a greater degree of fineness permits them to ignite more readily; and caking coals

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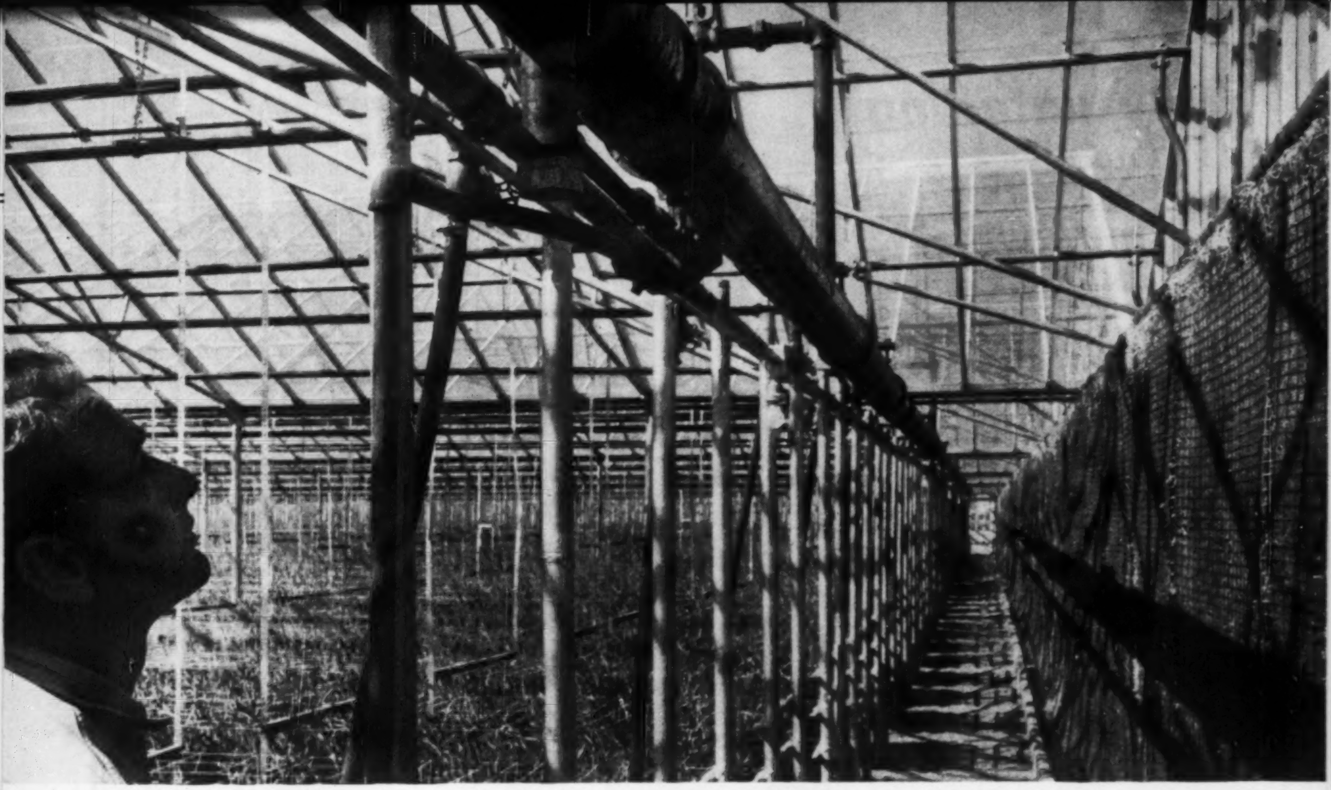

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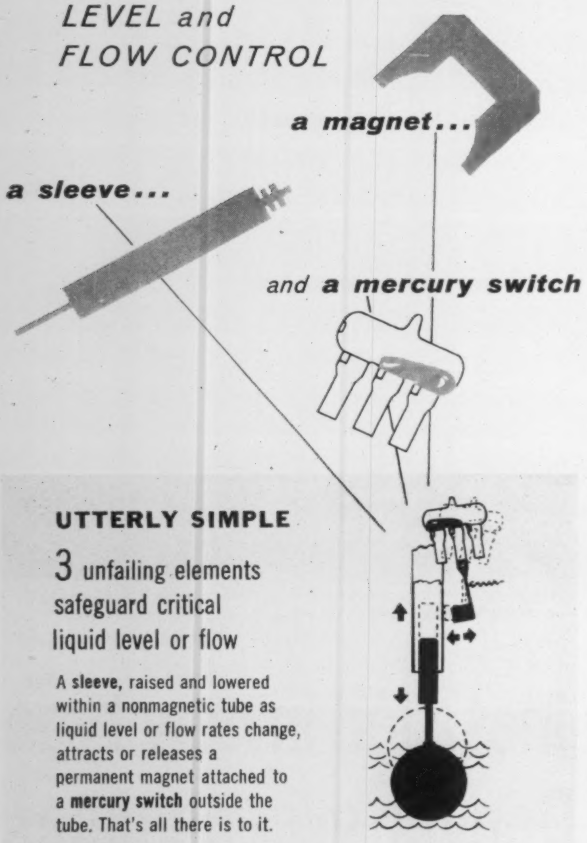

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COAL—

what every engineer should know

Continued

because of the tendency to coke and form particles light enough to be carried out of the furnace in an unburned condition. The actual fineness required varies from subbituminous and lignite coals ground to permit 60 percent or more to pass a 200 mesh screen, to low volatile bituminous and anthracite to permit 85 percent or more to pass.

Q. What equipment is used to pulverize coal?

A. Ball or tube mills — in which 1 to 2 in. diameter steel balls crush the coal during the rotation of the mill; impact mills — in which swinging arms or hammers strike the coal; ball-and-race or ring-and-roll mills — in which the coal is crushed between two rolling surfaces. In all these types, much of the pulverization is also caused by contact between the pieces of coal themselves.

Q. What are the friability and grindability indices? How are they determined?

A. The *friability* index indicates the tendency of a coal to break up or crumble during handling; the *grindability* index indicates the ease or difficulty with which it can be pulverized. To determine the friability index, coal 1 to 1½ in. in size is tumbled in a jar under prescribed conditions. The percentages which will then pass through a screen of specified size is used to determine the friability index. Related to this is the slack index which indicates the percentage of fine coal which will pass through a ¾ in. screen (ASTM D441-45). To determine the grindability index, two methods are used: the ball mill and Hardgrove. In the more popular Hardgrove method, a sample is passed through a pulverizer which rotates through a prescribed number of revolutions. The fines which will then pass through a 200 mesh sieve are weighed and the Hardgrove grindability index (HGI) determined by: $HGI = 13 + 6.93\,W$, where W is the weight of passing fines (ASTM D409 — 51). In the ball mill method, a 500 gram sample of coal is put into a mill loaded with 100 one in. steel balls. The coal is initially sized between 12 and 200 mesh. The mill revolves until 80 percent of the coal can pass through a 200 mesh sieve. The total number of revolutions of the mill required is used to determine the ball mill grindability index by: $BMGI = 50{,}000/R$, where R is the number of revolutions. The same coal will have a different index for each of the two methods and there is no mathematical relationship by which one index can be determined accurately from the other. ⧺

"Here's why I standardized on H&M cooling towers

. . . they're the only towers with a 20-Year Guarantee on the wetted deck surface!

"In my town, most air conditioning and refrigeration buyers prefer cooling towers for their installations. But local water conditions are pretty hard on the fill. Fungus and algae grow fast and furious—so fast that the accumulation actually blocks air flow and cuts tower capacity!

"After trying several makes, I standardized on H&M Cooling Towers. *The wood fill is specially treated with creosote applied under pressure*, and water plants and animals can't live on that! That's why the Halstead & Mitchell towers carry a 20-Year Guarantee on the wetted deck against failure due to fungus attack or rotting."

If you want towers that will last, and need a minimum of care, you should find out about H&M towers. Call your local parts wholesaler or write for Bulletin EC-500 (Propeller Fan Towers, 3 to 150 tons) or Bulletin ECKB-601 (Centrifugal Fan Towers, 5 to 30 tons). Halstead & Mitchell Co., Dept. C-5 Bessemer Building, Pittsburgh 22, Pa.

HM

Halstead & Mitchell

Cooling Towers • Air-Cooled Condensers • Air Handlers and Coils • Water-Cooled Condensers

Export Representatives: Sabal-Kielmann, Inc., 15 William St., New York 5, N. Y.

20-Year Guarantee

DART
This True Ball Joint Makes the Difference

DARTS ARE THRIFTY ON THE POCKETBOOK

. . . TIGHT ON THE LINE!

Yes sir, Dart Unions cut costs because

1. They last longer — their two bronze seats are precision ground to a true ball joint.
2. They're easy and fast to install.
3. They *stay* tight — damage no property, spoil no work.
4. They can be used over and over again.

Which is why the answer to "How thrifty, how tight *can you get* is . . . GET DARTS"!

QUICK FACTS

- Leakproof because precision-machined to a true ball joint and spherically ground
- Shoulders are heavy — can take abuse
- Each Dart is individually vacuum-tested
- Bronze alloy seats are extra wide, resist pitting and corrosion
- Practically indestructible nut and body — of air-refined, high-test malleable iron

DART UNIONS *Products of* **DART UNION COMPANY PROVIDENCE 5, R.I.**

GENERAL SALES AGENT

THE **Fairbanks** COMPANY
393 LAFAYETTE STREET, NEW YORK 3, NEW YORK
BRANCHES: NEW YORK 3
PITTSBURGH 22 • BOSTON 10 • ROME, GEORGIA

AVAILABLE THROUGH YOUR LOCAL DISTRIBUTOR

EQUIPMENT DEVELOPMENTS

Continued from page 203

Thermometers for Vapor Tension Equipment

Thermometers serve as remote temperature indicators for equipment such as air ducts and temperature operated valves. Units are center back connected, normally panel mounted. Dial sizes are 2, 2½, and 3½ in. in diameter. Drawn metal cases house the back-connected internals. Bourdon tube made of nonferrous metal; movement composed of corrosion resistant material. Standard dial ranges vary from −20 to 65 F as a minimum to 200 to 450 F as a maximum. — *American Machine & Metals, Inc., U.S. Gauge Div., Sellersville, Pa.*

Floatless Liquid Level Control For Remote Pump Application

Unit uses type "L" relay for remote control of pumps. Relay can be installed with the motor control box at pump location. Control can be installed underground or overhead by any one of four basic methods. Information sent on request. — *The B/W Controller Corp.,* 2200 *E. Maple, Birmingham, Mich.*

High-Flow Filter Stops Dirt at Hose End

Filter for nozzle-end hose and pipeline installations. Contains a stainless steel coneshaped wire cloth filter element that provides 10-micron filtration at differential pressures up to 150 psi. Available in 10½, 14½, and 17½ in. lengths to accommodate flow rates of 300, 360, and 720 gpm respectively, at ambient temperatures. Unit monitors effectiveness of existing "upstream" primary filter installations and provides a backstop to collect contaminant "downstream." — *Purolator Products, Inc., Department* 203, *Rahway, N.J.*

Keflex Manufacturing Division

U. S. Flexible Metallic Tubing Co.

Since 1905

KEFLEX

LAMINATED
STAINLESS STEEL BELLOWS
See Our Catalog in Sweet's Files

General Offices — 63 Main St.,
San Francisco 5, Calif.
Factories — Los Angeles —
San Francisco
Sales Offices — Agents in Principal
Cities of U. S. and Canada

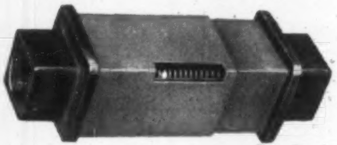
KEFLEX QUADRA-SIDE EXPANSION COMPENSATORS

FOR STEAM AND HOT WATER HEATING SYSTEMS USED WITH CONVECTOR AND FIN TUBE BASEBOARD RADIATION UNITS IN SCHOOLS, HOSPITALS, OFFICES AND COMMERCIAL INSTALLATIONS

TYPE 7 Q square brass telescoping case protects laminated stainless steel bellows from torsion, squirm, misalignment and external damage. Compensators are used in high and low pressure hot water supply lines, risers and for baseboard radiation. Extra flexibility provides maximum cyclic life. Units are very compact and rugged. Sizes ¾" thru 3". Pressures to 300 PSI. Temperatures to 800°F. Traverse: Single Units, total 2" (1-½" compression, ½" extension) Dual units available.

TYPE 11 Q-T has heavy square telescoping case and laminated stainless steel bellows. For use in risers and with baseboard radiation. Test pressure 150 PSI, working pressure 100 PSI, temperatures to 300°F. Traverse: Total 1" (¾" compression, ¼" extension).

TYPE 7 Q WITH BRASS FEMALE THREADED ENDS
Working Pres. 300 PSI Maximum
Temp. 800 F



Pat. Pend.

Nom. I.P.S.	Overall Length	Max. O.D.	Wt. #
¾"-1.00"-1.25"	6.50"	2.00"	2
1.50	6.50	2.50	4
2.00	6.50	3.00	5
2.50	6.50	3.50	6
3.00	6.50	4.00	9

TYPE 7 Q-T WITH COPPER TUBE ENDS
Maximum Pres. 200 PSI Maximum
Temp. 300 F

Pat. Pend.

To Fit Copper Tubing		Overall Length	Max. O.D.	Wt. #
Nominal I.D.	Actual O.D.			
¾"	⅞"	6.50"	2.00"	1½
1	1⅛	6.50	2.00	1½
1¼	1⅜	6.50	2.00	1½
1½	1⅝	9.00	2.50	3½
2	2⅛	10.00	3.00	4½
2½	2⅝	10.75	3.50	5½
3	3⅛	11.50	4.00	8¼

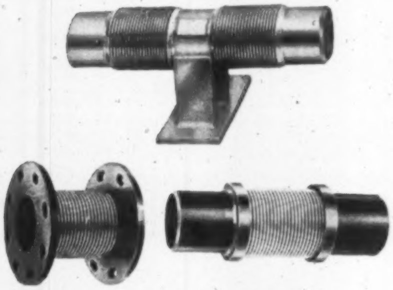
TYPE 11 Q-T WITH COPPER TUBE ENDS
Maximum Pres. 100 PSI Maximum
Temp. 300 F

Pat. Pend.

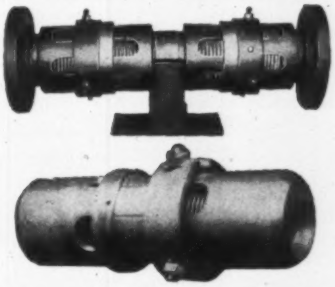
To Fit Copper Tubing		Overall Length	Max. O.D.	Wt. #
Normal I.D.	Actual O.D.			
¾"	⅞"	4.50"	1.50"	1¼
1	1⅛	4.50	1.50	1¼
1¼	1⅜	4.50	1.75	1½
1½	1⅝	4.50	2.25	3
2	2⅛	4.50	2.75	4

EXPANSION JOINTS—VIBRATION ABSORBERS—FLEXIBLE CONNECTORS—PIPE GUIDES

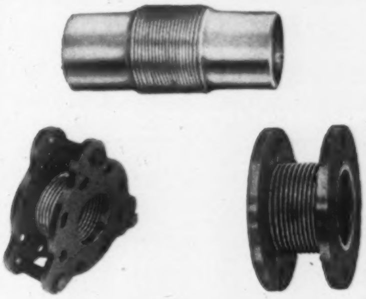
Force Required to Compress Keflex Expansion Joints Their Full Rated Traverse is Usually Less Than 100 Lbs., Total



KEFLEX EXPANSION JOINTS — corrugated, packless type for steam and hot water heating systems and process piping. Laminated stainless steel bellows with internal liner guides and stainless steel contour control rings. Weld ends, or flanges. Outside shrouds and intermediate anchor bases available. Sizes 2" through 48". Pressures 70 to 450 PSI. Temperatures to 800° F. Furnished for various required traverses.

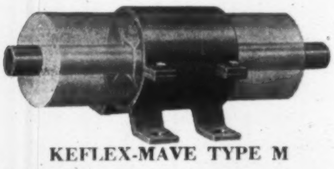


KEFLEX-KETROL CONTROLLED EXPANSION JOINTS — positive protection against torsion. For use in pipe lines to compensate for expansion and contraction. Shroud has intermeshing fingers providing concentric guiding and protection against squirm, torsion, and external damage to laminated stainless steel bellows. Designed for high pressure, high temperature hot water service. Movement is controlled by limit stops. Sizes 2" through 48". Pressures to 450 PSI and temperatures to 800° F.



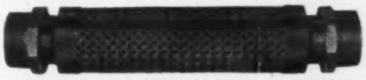
KEFLEX FLEXIBLE CONNECTORS AND VIBRATION ABSORBERS — to absorb vibration from pumps, chillers, and compressors. Serves to relieve stress on pump volute when piping is misaligned. Extra flexibility of laminated stainless steel construction produces long cyclic life. Compact units save space and are easy to install. Available with or without tie rods. Sizes 2" through 48". Pressures to 450 PSI and temperatures to 800° F.

Modified Types are available for special conditions requiring higher pressure, temperatures, traverse, or combination deflections.



KEFLEX-MAVE TYPE M

Fabricated steel pipe guides for concentric guiding of pipe lines. Special insulated guides are available for chilled water.



FLEXIBLE "BMH" CONNECTORS

"USF" BRONZE VIBRATION ABSORBERS

Braided bronze Metal Hose assemblies made in standard lengths. Usually used as flexible connectors on pumps and other mechanical equipment for heating and air conditioning service. Available with threaded male ends, flanges, and copper tube sweat ends.

new technology in WOVEN WIRE CLOTH for gas fired INFRA-RED BURNERS

More and more manufacturers are using woven wire cloth as the most practical burning surface for gas fired Infra-Red Heaters. Woven wire cloth has proved its efficiency and economy for both pre-mix and gravity type burners. What's more, woven wire is rugged and reliable—withstands the rigors of expansion and vibration—endures broad ranges of temperature cycling.

The majority of Infra-Red users of woven wire cloth rely on Cleveland Wire Cloth to supply their requirements and for good reason. We have cooperated with combustion engineers, taking their specifications and designing them into highly efficient woven wire Infra-Red burners. Through continued research, we are developing new and better applications for woven wire cloth burning surfaces. Let us apply this new technology to your Infra-Red burning problems.

Free — Bulletin 160 containing the full range of square mesh and square opening space cloth available from Cleveland.

THE CLEVELAND WIRE CLOTH
AND MANUFACTURING COMPANY
3585 East 78th Street • Cleveland 5, Ohio • Phone DI 1-1832

CLEVELAND WIRE CLOTH

Cast Aluminum Ventilators Available in 18 Modular Sizes

Brick size vents for air intake or exhaust for unit air conditioners, ventilation of boiler rooms, and similar applications. Module in standard and jumbo brick, cinder, and concrete block construction. Units will not rust, fracture, or strain adjacent building structure. Aluminum wire screening standard; other screens available. Bulletin sent on request. — *Construction Specialties, Inc.,* 55 *Winans Ave., Cranford, N.J.*

Liquid Level Gage Provides Visual Read-Out

Unit provides visual read-out of liquid level variations in refrigerant vessels. Available with single or multiple control switches to provide automatic operation of pumps, valves, indicator lights, alarm bells, etc. Unit has five major parts: float chamber; guard section; control switch or switches; combination float ball, rod, and magnet-indicator; and indicator glass. Has no outside parts. — *H. H. McKinnies Co.,* 3131 *W. Mill Rd., Milwaukee.*

Temperature Probes For Gas Measurement

"TD" temperature probes for measurement in gases at velocities of 100 to 200 ft per sec and temperatures up to 500 F. Thermocouple elements can be furnished in standard iron - constantan, copper - constantan, and chromel-alumel wires. Element coiled to expose maximum surface to the gas to eliminate conduction errors. Information sent on request. — *United Sensor & Control Corp., P.O. Box 149, Glastonbury, Conn.*

NOW
THE FAMOUS "NO MAINTENANCE" PRESSURE REDUCING VALVE WITH NEW STEEL BODY

The Leslie GP-type pressure reducing valves are recognized as the simplest, most rugged, most maintenance-free ever made. Sold under Leslie's famous 3-year no-maintenance guarantee, they have so far been available with cast iron or cast bronze bodies only.

To satisfy the heavy demand for GP performance and construction features in 150, 300 and 600 lb. steel-body valves, here is the new Class GPS valve in carbon steel and alloy steels for steam, air, gas and other vapors.

The design still uses only two moving parts—a Spiroflex diaphragm and the main valve. These are virtually indestructible. There is nothing to wear out.

The low-stress diaphragm is the patented Leslie-Spiroflex®, which flexes like rubber but resists temperature as only a metal diaphragm can. Look at the cage trim construction—proved in Leslie-Lifetime control valves. Hardened stainless steel main valves seat on easily renewable, "permanent" type, stellited seat inserts. An unbeatable combination for long, trouble-free life.

The man to show you how much money this design will save you is your nearest Leslie Engineer. He is listed in the Yellow Pages under "Valves" or "Regulators." You will also want to send for our Product Data Sheet No. 611.

SPECIFICATIONS—Reducing Valve, GPS Classes

Sizes: ½" to 2" screwed or welding ends, or 150 lb., 300 lb. and 600 lb. flanges in carbon steel and alloy steels. Inquire about 2½ to 4" sizes soon to be available.

Diaphragm: Leslie-Spiroflex®, Stainless Steel.

Main Valve: Type 440C Stainless Steel, hardened.

Seat Ring: Stainless Steel, Stellited.

Stem Guides: Gun Metal Bronze (top and bottom guided).

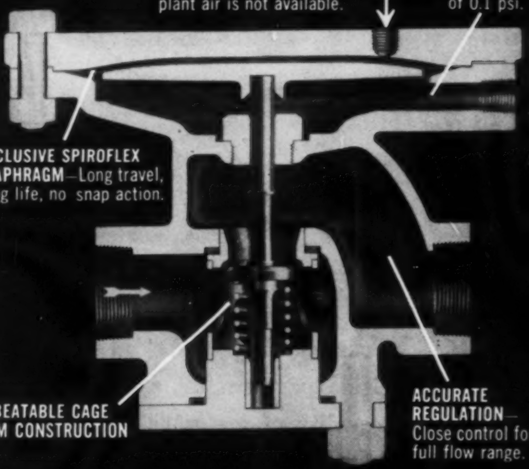
Main Valve Spring: Inconel.

Inlet Pressure Range: 600 psi, 600°F.

Reduced Pressure Range: 0-300 psig.

Minimum Pressure Drop across Valve: ½ psi.

Leslie Co., 703 Grant Ave., Lyndhurst, New Jersey


AIR-LOADED WITH SIMPLE AIR LOADER—Also available with either Piggy-Back air reservoir or spring loading where plant air is not available.
ACCURATE RESPONSE Sensitive to changes of 0.1 psi.
EXCLUSIVE SPIROFLEX DIAPHRAGM—Long travel, long life, no snap action.
UNBEATABLE CAGE TRIM CONSTRUCTION
ACCURATE REGULATION—Close control for full flow range.

TRADE LESLIE MARK

LESLIE REGULATORS AND CONTROLLERS

A SINGLE STANDARD OF QUALITY SINCE 1900

PRESENTING

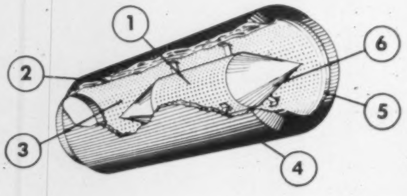
the new *HIGH VELOCITY*

Stream Line

TUBULAR

The dramatic new TUBULAR combines advanced aero-acoustical design with excellent HIGH VELOCITY air flow characteristics, achieving maximum noise reduction through the use of FREE-AIR body principle. Available in standard or custom sizes. American Engineering Company's precision production system assures you of the highest quality of materials and workmanship at truly affordable prices.

1. Streamline Air Body 2. Fiber Glass Packing 3. Heavy Gauge Galvanized Perforated Steel Interior Shell 4. Heavy Gauge Galvanized Sheet Steel Exterior Shell 5. Connection Flange 6. Exclusive Needle-nose design; Heavy Gauge Sheet Steel



Specifications and Performance Data available on request

AMERICAN ENGINEERING COMPANY

Originators & producers of *Stream Line* sound control units.

High Point Industrial Park • Sedalia, Missouri

Pressure Regulators Available In Direct and Reverse Models

Units in both direct and reverse acting types for use with steam, air, water, and gases that are non-corrosive to bronze, iron, or neoprene. Available with single and double seats. Feature packless valve that permits immediate response to pressure change. Available in all sizes from ½ through 2 in. Valve body is heavy bronze; diaphragms are heavy gage, flexible neoprene impregnated nylon; upper diaphragm housing assembly is stainless steel. Also features bellows-equipped valve stem, disc, and seat rings. Bulletin 116 sent on request. — *Manning, Maxwell & Moore, Inc., Stratford, Conn.*

Cushion Clamps for Temperatures to 1500 F

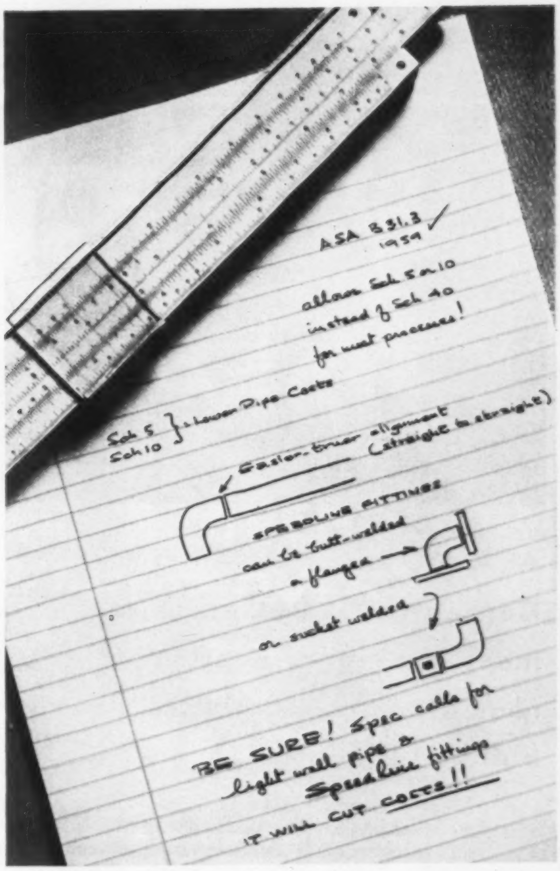
All stainless steel (type 321) cushion clamps for temperatures up to 1500 F. Cushion corrugated to furnish a spring action for high frequency, low amplitude vibration. Available in sizes from ¼ to 4 in. ID; interchangeable with any standard ½ in. AN, MS, or commercial type cushioned loop clamps. Cushioning is spot welded to clamp; cushion edges are crimped for abrasion-free grip. — *TA Manufacturing Co., 4607 Alger St., Los Angeles 39.*

Intake and Relief Ventilator Has Glass Fiber Construction

Unit has low profile and is weather resistant. Available in throat sizes from 10 to 60 in., either square or rectangular. Accessories include all types of dampers. Twelve colors are available. — *Williams-Bermuda Corp., 310 N. Normandia Ave., Los Angeles.*

PROCESS PIPING STANDARDS HAVE CHANGED

IT WILL PAY YOU TO BE UP-TO-DATE


ASA B31.3 1959 ✓
allows Sch 5 or 10 instead of Sch 40 for most processes!
Sch 5 Sch 10 } = Lower Pipe Costs
Easier-truer alignment (straight to straight)
SPEEDLINE FITTINGS can be butt-welded or flanged →
or socket welded
BE SURE! Spec calls for light wall pipe & Speedline fittings
IT WILL CUT COSTS!!

If you're familiar with the latest issue of the Code for Pressure Piping ASA B31.3, you know process piping standards have changed. Pressure-Temperature operating conditions should be re-evaluated. Now *your* specifications can take advantage of economical *light wall* pipe and improved *Speedline fittings design* to meet the most critical process line requirements!

Once you "up-date" your specifications via this new code, important cost savings follow *down the line.* Savings in materials cost are definite—Schedules 5 and 10 stainless pipe simply *costs less.* Speedline fittings design accounts for significant additional savings in the total installed cost.

The Speedline "extra length" feature makes it easier to butt-weld joints . . . assures faster, truer alignment every time because connections are always made "straight to straight". All types of flanged connections, too, can be made more readily . . . without fouling problems—even welding can be eliminated with Speedline Insert Flanges—just roll them on.

Speedline's design advantages give complete freedom of choice—you can butt-weld, flange, socket weld or use unions . . . and *one fitting* can be used *all ways* when Speedline is specified.

Real economy in process piping is a matter of *specifications*—and Speedline fittings. Make the most of *both.* Study ASA B31.3-1959 for up-to-date data on light wall lines for *your* application. Get detailed data on bonus savings possible *only* with Speedline corrosion-resistant fittings. The Speedline Distributor near you is listed on Page 1494 of Chemical Engineering Catalog. Call him today.

Speedline®

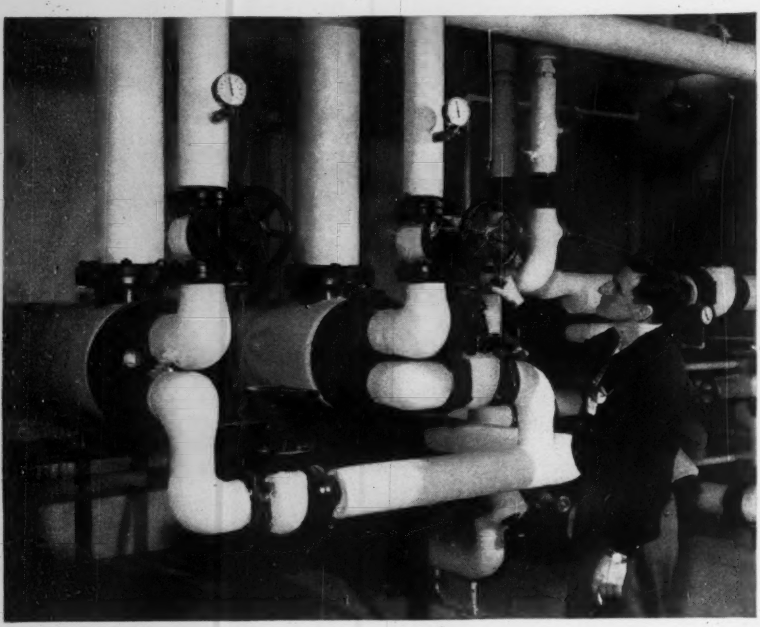
CORROSION-RESISTANT FITTINGS

STAINLESS STEEL • ALUMINUM • SPECIAL ALLOYS

200

A PRODUCT OF **HORACE T. POTTS COMPANY** • 576 E. ERIE AVENUE, PHILADELPHIA 34, PA.

GENERAL converters provide
CLOSE HEAT CONTROL

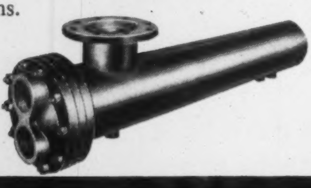


At AVCO's new Research Center, GENERAL units meet individual heating requirements of multi-building complex!

Research & Advanced Development Division
AVCO Manufacturing Corp.
WILMINGTON, MASS.
Engineers: METCALF & EDDY, Boston, Mass.
Contractor: FRED WILLIAMS, INC., Boston, Mass.
Architect: PEREIRA AND LUCKMAN, Los Angeles, California
Wholesaler: CHARLES D. SHEEHY, So. Boston, Mass.

Each building in AVCO's spacious new Research and Development Center is equipped with its own set of steam to hot water converters. Twelve converters, operating on steam from a main boiler room, provide maximum radiation efficiency, better utilization of space, and closer heat control. Extremely close temperature control required in some heating zones is accomplished without critical adjustment or complex equipment.

Compact General converters permit maximum installation flexibility . . . require minimum piping. There's a General application-rated unit designed to meet your exact radiation or space heating requirements . . . from 1 to 1800 gpm . . . in 4″ to 28″ diameter sizes. Request Bulletin 63A and see why General converters were selected for some of the country's largest installations.



GENERAL FITTINGS COMPANY
EAST GREENWICH · RHODE ISLAND

EQUIPMENT DEVELOPMENTS

Continued

Control Valves for Remote Operation

Remote control valves for inaccessible areas such as fume and dust areas, sterile enclosures, radioactive processes, buried lines, tower and roof lines, steam chambers, and submerged piping. Model "25" valves operated hydraulically through plastic or copper tubing that links them with a hydraulic controller. Model "1825" valves incorporate a solenoid and are connected by wiring to an off-on switch. Both types made of cast bronze and rated for 150 psi water at 150 F. Both close automatically in event of power failure. — *Febco, Inc., 1993 Blake Ave., Los Angeles 39.*

Rectangular Fasteners Have Built-In Hinge

Fasteners available in almost any square or rectangular shape. Features built-in hinge and key nut for securing fastener and allowing any degree of mechanical take-up desired. May be opened or closed indefinitely without fatigue of metal. All components are captive so parts will not become loose. TA5006 print sent on request. — *TA Manufacturing Corp., 4607 Alger St., Los Angeles 39.*

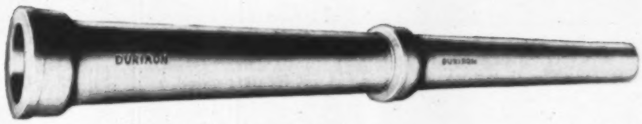
Gas-Fired Water Heaters Have Up To 945,000 Btu Per Hr Input

Vertical automatic units have up to 945,000 Btu per hr input with a storage capacity of 217 gal; delivers 793 gal recovery per hr at 100 F temperature rise. Operates on natural, mixed, or LP gas. Equipped with two magnesium rods. Mounted controls are self-generating. Units are AGA and ASME approved. Literature sent on request. — *Ewing Manufacturing Co., 2545 NW 10th, Oklahoma City, Okla.*

DURIRON PIPE

FOR CORROSIVE WASTE DISPOSAL

IT'S BETTER
BETTER FOR THE ENTIRE SYSTEM
BETTER IN THE APPROVED METHOD OF INSTALLATION
PROVEN FOR OVER 40 YEARS


DURIRON
DURIRON

BETTER FOR THE ENTIRE SYSTEM... Put in the complete job in *Duriron*. Embed it in concrete . . . Bury it in the ground . . . Hide it above the false ceiling . . . *and forget it!*

BETTER INSTALLATION... By standard plumbing practice—identical to soil pipe. With a full line of fittings to meet any building code.

PROVEN FOR OVER 40 YEARS... In handling corrosive wastes you've got to be sure. *Duriron* is the only material with a record of performance for the life of a building.

The complete acid-drainage system in *Duriron* will be *better* all around. Safety and assurance to the owner . . . complete ease of mind to the specifier . . . and facility in plumbing to the contractor.

THE DURIRON COMPANY, INC. DAYTON, OHIO DURIRON

SPECIFY General RUBBER

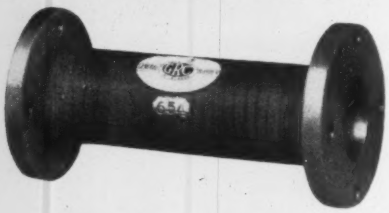
Custom-Made

FLEXIBLE RUBBER EXPANSION JOINTS AND PIPE for your WATER · BRINE · GAS CHEMICAL · PIPE LINES

- Absorb Vibration, Noise and Water Hammer
- Prevent Expansion-Contraction Stresses
- Compensate for Minor Misalignment
- Stop Galvanic Action

RUGGED, LONG LIFE

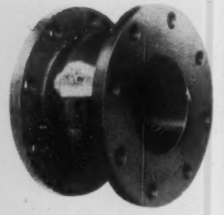
FLEXIBLE FLANGED RUBBER PIPE



General Rubber offers two complete, time-tested lines of full-faced, flanged rubber pipe for air conditioning and heating systems. Both lines are made in standard pipe sizes from 1" to 12" for either 150 p.s.i.g. or 250 p.s.i.g. pressure service or for 30" Hg vacuum service.

Type F Full-Faced Flanged Rubber Pipe. General Rubber's Type F flexible rubber pipe is made with full-faced, integral rubber flanges. Installed with our galvanized steel split retaining rings, the resilient rubber flanges form a tight seal against the pipe flange without the need of gaskets. Bulletin 580.

SoundZorber® Wire-Reinforced Rubber Pipe. The rugged heavy-duty SoundZorber pipe repays its cost many times over. Its unique solid molded rubber flanges, with built-in steel flanges, will operate under the most adverse conditions. Bulletin No. 866.



Type GRC Rubber Expansion Joints. Long life, custom-made Type GRC Expansion Joints are available for pressures up to 150 p.s.i.g., in sizes from 1" to 72" I.D. Flexing action keeps rubber "alive," free from embrittlement and scale formation. Particularly valuable in systems handling corrosive and abrasive chemicals. Catalog No. 888.

OTHER GRC FLEXIBLE UNITS

- Screwed coupling Type S flexible pipe in standard pipe sizes from ¾" to 3". Bulletin No. 580.
- New Type G, Gen-Lok reinforced flanged flexible pipe for fast, perfect bolt hole alignment. Bulletin No. 580.

General RUBBER CORPORATION
50 SUMMIT STREET · TENAFLY, N. J.
TELEPHONES: N. Y. – OXford 5-0328 · N. J. – LOwell 7-0222

GRC TECHNICAL SERVICE IN RUBBER

EQUIPMENT DEVELOPMENTS

Continued

Solenoid Valves for Hydraulic System Application

Two and three way high pressure exposion-proof solenoid valves for hydraulic system applications. Stainless steel, direct acting, slide type units for pressures up to 2000 psi. Inlet is 3/32 in. and cylinder orifices have ⅛ in. NPT. Can be used as two way normally open or normally closed valves, or as three way normally closed, normally open, or dual purpose valves. — *Skinner Precision Industries, Inc., Electric Valve Div., New Britain, Conn.*

Thermostat Has Manual Reset

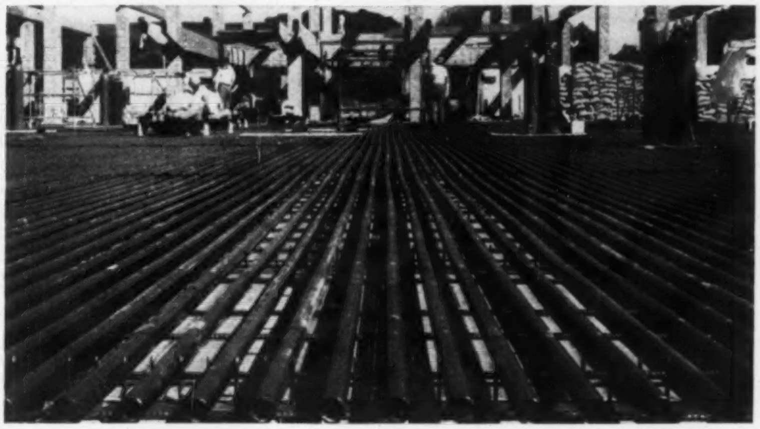
Manual reset, non-adjustable limit control has snap-acting bimetal disc that opens contacts when temperature limit is reached. Current carrying members of "WA-14" unit independent of reset button; pressing reset button does not disconnect contacts. UL listed for up to 350 F at 25 amp resistive, 120/240 v a-c. Inductive load ratings, various mounting flanges, and terminal arrangements given in Bulletin 37-A, sent on request. — *Therm-O-Disc, Inc., Mansville, O.*

Filter Grille Has Hinged Frame

Grille has face bars stamped ½ in. wide on a ½ in. center and a 30 deg deflection. Can be installed with deflection either up or down. Filters recessed approximately 1 in. behind grille face. All standard 1 in. thick permanent or replaceable filters can be used. Unit available in all standard stock and non-stock sizes. — *The Auer Register Co., 6600 Clement Ave., Cleveland 5.*

BYERS GUIDE

Tips on How to Minimize Corrosion Costs from A. M. Byers Co. VOL. 2, NO. 4



This 120 x 208 foot artificial ice rink at Pittsburgh's North Park used 1¼-inch Byers 4-D wrought iron pipe to carry the brine refrigerant. "U-bends" fabricated from extra heavy wrought iron pipe will be welded to these pipe ends. Shown are workmen welding random lengths of wrought iron pipe. Background shows superstructure of the $500,000 clubhouse.

Two Pittsburgh Ice Skating Rinks Piped With 4-D Wrought Iron

Pittsburgh, Pa., now boasts two of the largest outdoor artificial ice skating rinks in the country—North Park and South Park rinks. Both rinks are of the permanent type with wrought iron brine lines embedded in a concrete slab which is surfaced with terrazzo.

Skating area of the South Park rink is 97 by 232 feet, while the North Park measures 120 by 208 feet. 4-D wrought iron pipe specified for the two rinks was laid on 4-inch centers. (Supply and return piping 6, 8 and 10 inches in diameter was also 4-D wrought iron.)

The permanent type of ice rink is the more profitable since it lends itself to year-round use. During the off season the ice rink area can be used for roller skating, dances, concerts and other kinds of outdoor activity.

A permanent rink can be viewed as a long-term investment, so the use of 4-D wrought iron makes a great deal of sense. The built-in corrosion resistance of wrought iron is well known. The reason it can stand up to the corrosion attack of brine lies in its unique two-component character. Every cross-sectional square inch of the pure iron is laced with 250,000 fibers of iron silicate. It is these fibers which are responsible for wrought iron's corrosion and fatigue resistance. Facts and figures are yours for the asking—use the coupon.

Help Eliminate Water Pollution—Specify 4-D Wrought Iron Pipe

Because pipe failure in water wells can cause pollution, many municipal water supply systems are being piped with corrosion resistant wrought iron. Recently, twenty housed water wells in Wichita, Kansas, called for 10-inch diameter Byers 4-D wrought iron pump column pipe and 2½-inch pump shaft enclosing tube. Wells average 81 feet in depth.

Wrought iron was chosen because of outstanding performance in water well applications. For example, a municipal well cased with 10-inch wrought iron pipe was pulled after 52 years of continuous service so that the well could be enlarged. Close examination of the casing showed it to be in good condition, despite 52 years of service. For details on this and other case histories —use the coupon.

Unique Swimming Pool Has 4-D Protection

Built in the shape of a huge "T," the new Atlanta Athletic Club swimming pool was designed to take advantage of earth grading.

Both club officers and the engineer in charge wanted to assure minimum maintenance costs. That's why Byers galvanized 4-D wrought iron pipe was specified for main pool branch supply and drain laterals, wading pool supply lines and display spray piping for both.

4-D resists the corrosive effect of aggressive waters, its superior durability shows up well in applications where piping may be alternately wet and dry. For information on how 4-D can cut maintenance costs for you, use the coupon.

A. M. BYERS COMPANY

PIPE PRODUCTS: Wrought Iron • PVC • Steel
ROLLED PRODUCTS: Plates, Billets and Bars • Wrought Iron, Stainless and Alloy Steel

A. M. Byers Company, Clark Building, Pittsburgh 22, Pa.
Please send data on items checked:
☐ Wrought Iron Pipe Catalog ☐ Report on Ice Rink Piping
☐ Piping for Permanence

Name__________ Title__________
Company__________
Address__________

LIGHTEST,

most powerful

4″ segment bender

on the market

Greenlee No.777

(1-1/4″ thru 4″)

weighs only 65 lbs.

(exclusive of shoes)

Save time, cut costs on piping installations with the new Greenlee No. 777 that does more jobs for you than any other bender of its type. Use it to make large sweeps, concentric bends, offsets, 90° bends right on the job. 27-ton ram has power to spare for bending steel or aluminum pipe 1¼″ thru 4″. A few optional parts adapt it to fast, one-shot 90° bending ½″ thru 2″. Easy one-man operation with hand or power pump. For more information write for Bulletin E-249.

The Greenlee line of timesaving hydraulic pipe benders also includes No. 880-M2 for ½″ thru 2″ . . . No. 883 for ½″ thru 3″ . . . No. 884 for ½″ thru 4″ . . . and No. 785 BE for 1¼″ thru 6″. All make 90° bends in one shot.

GREENLEE TOOL CO., 1952 Columbia Ave., Rockford, Ill.

GREENLEE JOB-PROFIT TOOLING

. . . cost control for contractors

you'll want to know

Continued from page 44

human beings. Investigations on the effect of ions on human comfort indicate that, in general, negative ions produce a pleasant feeling accompanied by relaxation and sleepiness. Positive ions are generally found to produce an unpleasant feeling accompanied by headache, dizziness, nausea, and sore throat.

Studies of the effects of ions on a person's performance have been less conclusive. For example, a study supported by the Air Force's Wright Air Development Division reported no statistically significant differences in performance with either positive or negative ions. The difficulty here lies in isolating the effects of ions from the effects of other environmental factors. Temperature, humidity, light, noise, or gases can all affect the behavior and performance of human beings. Behavior and performance are also influenced by the physical condition, age, and sex of the subjects; the degree and type of stress they may have undergone; previous ion exposure; and the type of performance tested.

One of the ways in which ions affect performance is illustrated by a Russian study. After 25 days of inhaling negative ions for a 15-min period daily, athletes maintained a standard grip on a dynamometer 46 percent longer than control subjects. After nine days of negative ion treatment, endurance as measured on a treadmill increased 55.9 percent.

Ion Theory

According to the Battelle scientists, theories as to how air ions affect the human body involve electrical, chemical, or hormonal mechanisms—either separately or

Continued on page 228

FOR TITAN MISSILE BASES...

1800 EXPANSION JOINTS OF STAINLESS STEEL

Air Force Titan missile bases require many miles of stainless steel LOX piping. To protect these piping complexes from thermal changes and shock conditions, special stainless steel expansion joints —1800 of them—were required.

Adsco built these special expansion joints, taking them carefully through design, forming, welding, and assembly. The expansion joints were cycle-tested with liquid nitrogen at -297° F. and cleaned. The Corps of Engineers inspected each one under black light and each joint was hermetically-sealed. System cleanliness limits were 25 parts per million —150 micron particles.

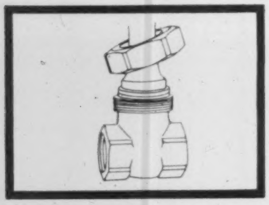
Knowledge and experience such as this could be of help to you in your expansion joint work. Call on Adsco!

ADSCO DIVISION
20 MILBURN STREET
BUFFALO 12, NEW YORK

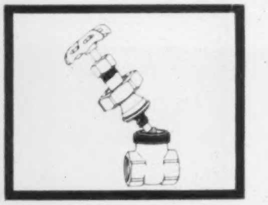
YUBA

YUBA CONSOLIDATED INDUSTRIES, INC.

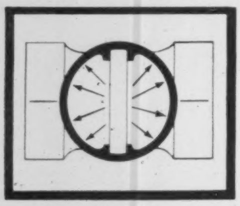
Get *MORE* for your Valve Dollar with KENNEDY Design Features



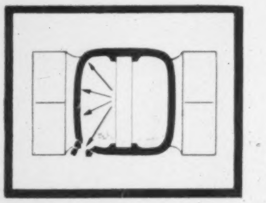
Kennedy's Union Bonnet permits repeated dismantling for cleaning or inspection and reassembly without danger of distortion of the valve. The bronze-to-bronze construction makes a tight union for tight, leakproof operation.



Kennedy's Fig. 525 can be easily disassembled into component parts for installation in otherwise inaccessable places in existing lines or for new installations.



Kennedy's cylindrical body construction when under severe pressure resists rupture and minimizes deflection thus preventing leakage at the seat.



Pressure in ordinary non-cylindrical valve bodies tries to push the body wall out to form a circle or cylinder. Rupturing stresses concentrate where wall has the shortest radius. Resultant deflection causes leakage over disc and early failure.

More reasons why KENNEDY is your best valve buy . . .

Rugged, wider hex ends, blended into body, prevent distortion. On a conventional valve body, hex ends protrude and are connected by thin body wrists. This area, under severe wrench pressure, can distort and cause disc seating trouble. Kennedy's wider hex ends are blended *into* the body making the body and hexes one unit. In this way wrench pressure can be absorbed.

Kennedy's Fig. 525 gives greater strength with less bulk and weight than any comparably rated valve. Fig. 525 can be repacked under pressure, eliminating line shut-downs. Simply open valve fully, remove packing nut and repack.

• *Write today for complete information.*

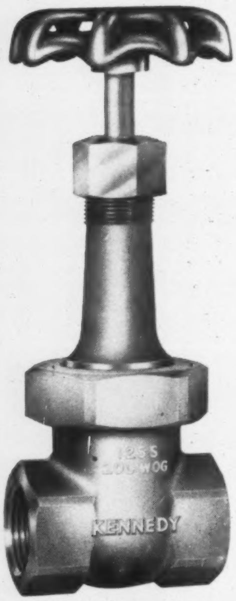


Fig. 525

125 lb. S.W.P. Bronze Gate Valve
Union Bonnet • Rising Stem
Inside Screw • Wedge Disc

KENNEDY VALVE MFG. CO.
ELMIRA, NEW YORK
VALVES • PIPE FITTINGS • FIRE HYDRANTS
• OFFICES AND WAREHOUSES IN NEW YORK, CHICAGO, SEATTLE, SAN FRANCISCO, ATLANTA • SALES REPRESENTATIVES IN PRINCIPAL CITIES •

you'll want to know

Continued from page 226

in some form of combination.

There are several types of electrical influence theories. One is that the biological effect of ions occurs in the cells of the body through a change in conductivity of the cell structure or the electric charge of the cell membrane. Another hypothesis states that ions act directly upon the autonomic nervous system by stimulating sensory nerve endings in the skin. According to a third theory, electricity is "metabolized" through the lining of the lungs and the red corpuscles.

The chemical mechanisms that have been suggested fall into two categories. The first concerns a change in atmospheric composition due to the presence of ions or the change in the activity of atmospheric gases. The second group postulates that the ion generator itself may produce gases and that it is these gases, rather than ions, which produce an effect. Of considerable interest is a study showing that air ionization effects the oxygen-carrying capacity of the blood by altering the relative acidity and alkalinity of the blood and its carbon dioxide combining power.

The most promising of the three general theories, in the opinion of Schutz and Duffee, is one involving the action of hormones advanced by A. H. Frey of General Electric's Advanced Electronics Center. The basis of this hypothesis is that the operation of ions on human beings may be due to an influence on the adrenal cortex and the subsequent change in the production of corticoids. This hypothesis is supported by the following observations: 1) atmospheric ions do affect the adrenal cortex; 2) the secretion of the different corticoids can vary inde-

Continued on page 230

The O'Keefe Centre

for the Performing Arts

TORONTO, ONTARIO

Architects: Earle C. Morgan and Page & Steele, Toronto
Mechanical Engineers: Forst, Granek & Associates, Toronto
General Contractor: Anglin-Norcross, Ontario, Ltd.
Mechanical Contractor: Universal Plumbing & Heating Co.

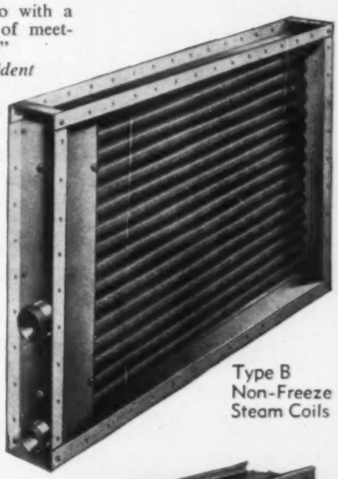
New 3200-seat theatre will "provide Toronto with a multi-purpose entertainment centre capable of meeting all tastes with the best facilities available."

T. E. Arkell, President

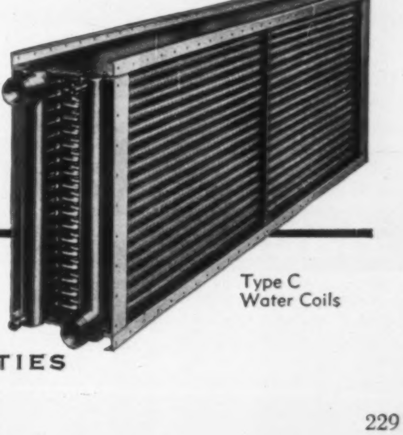
AEROFIN INSTALLED

Modern smooth-fin design of Aerofin coils permits ample heat-exchange capacity in limited space — permits the use of high air velocities without turbulence or excessive resistance.

Aerofin performance data are laboratory and field proved. You can safely specify Aerofin coils at full published ratings.



Type B
Non-Freeze
Steam Coils



Type C
Water Coils

AEROFIN CORPORATION

101 Greenway Ave., Syracuse 3, N.Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

ENGINEERING OFFICES IN PRINCIPAL CITIES

SAFETY ZONE
Babbitt
Adjustable
SPROCKET RIM
with Chain Guide
Changes that Danger Zone to a
SAFETY ZONE

—*enables you to*
ADD PLANT AREA

If re-aligning equipment will yield more working space, better production, lower costs—do it now. Save all space wasted for placing ladders to reach overhead valves. At the same time, convert Danger Zones to Safety Zones. Equip every overhead valve wheel in your plant with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. Just phone your mill supply salesman or contact us direct.

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STEAM SPECIALTY CO.
8 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

* you'll want to know

Continued from page 228

pendently of each other; and 3) there is a similarity between the effects of positive and negative ions and the action of the glucocorticoids and mineralocorticoids.

Value of 1960 Installed Central Air Conditioning Sets All-Time Record

THE INSTALLED COST of central station air conditioning systems that went into operation in large multi-room buildings and commercial and industrial applications in the United States during 1960 is estimated at $800,810,000. This compares with 716,570,000 in 1959, according to the Air-Conditioning and Refrigeration Institute.

The ARI figures are based on shipments in the U.S. of compressors, condensing units, absorption systems, and centrifugal and reciprocating liquid-chilling packages of 25 hp and over. They do not include any figures for brine chillers or equipment using ammonia as refrigerant.

Actual cost of the equipment included in the base is estimated at about 10 percent of the installed value of central station systems. The remainder includes air handlers, ducts, controls, insulation, labor, and all other installation costs.

Installed value of systems put into operation each year since 1950, based on figures reported to ARI is estimated at:

1950...........	$222,060,000
1951...........	252,890,000
1952...........	206,550,000
1953...........	255,360,000

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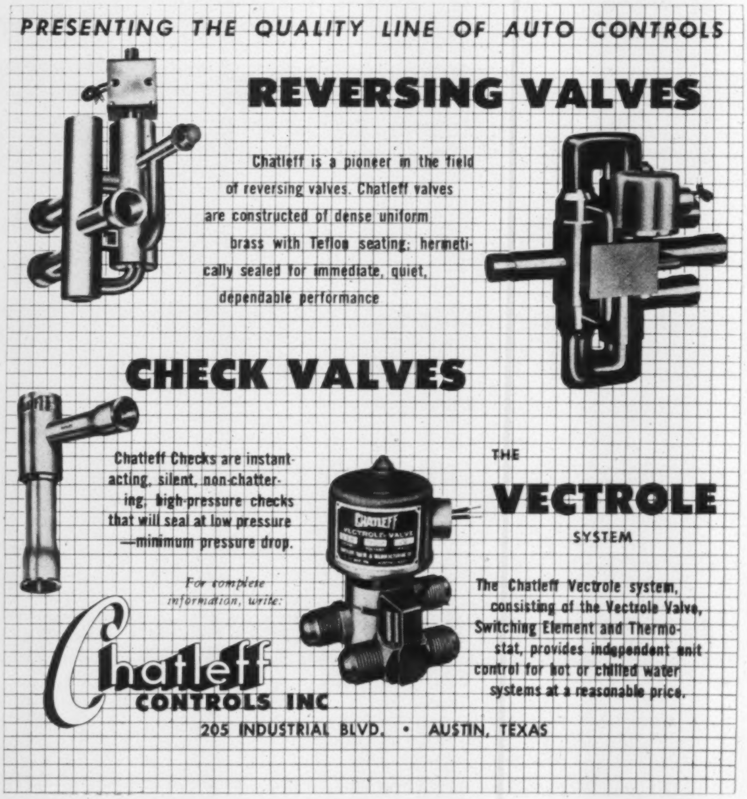

PRESENTING THE QUALITY LINE OF AUTO CONTROLS

REVERSING VALVES

Chatleff is a pioneer in the field of reversing valves. Chatleff valves are constructed of dense uniform brass with Teflon seating; hermetically sealed for immediate, quiet, dependable performance

CHECK VALVES

Chatleff Checks are instant-acting, silent, non-chattering, high-pressure checks that will seal at low pressure —minimum pressure drop.

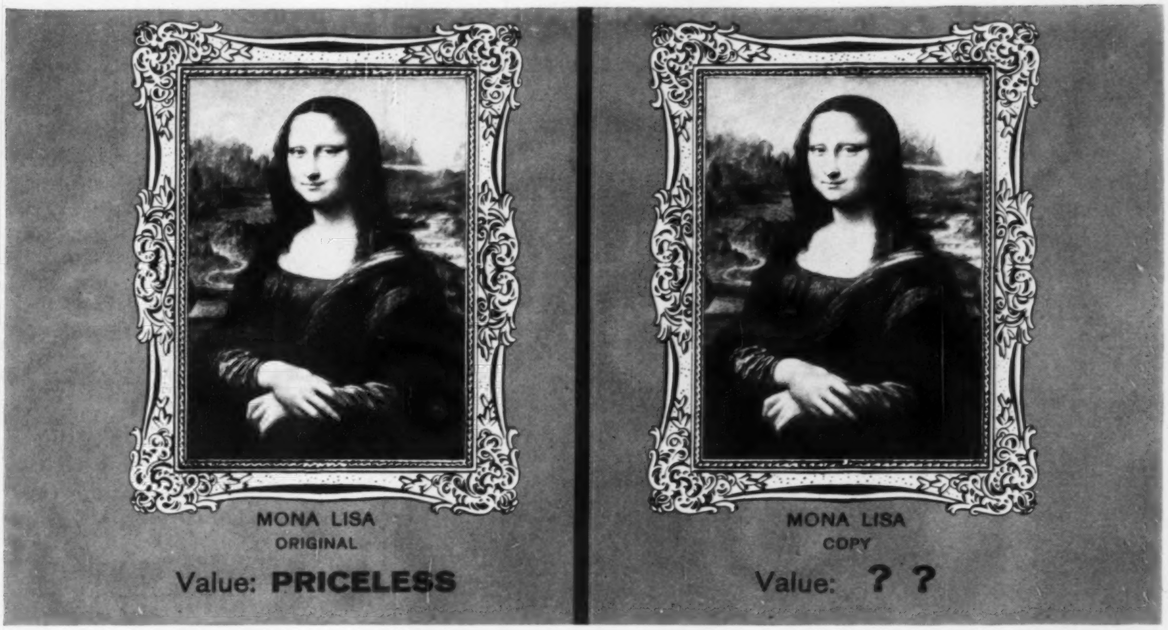
THE
VECTROLE
SYSTEM

The Chatleff Vectrole system, consisting of the Vectrole Valve, Switching Element and Thermostat, provides independent unit control for hot or chilled water systems at a reasonable price.

For complete information, write:

Chatleff
CONTROLS INC
205 INDUSTRIAL BLVD. • AUSTIN, TEXAS

When buying ART...



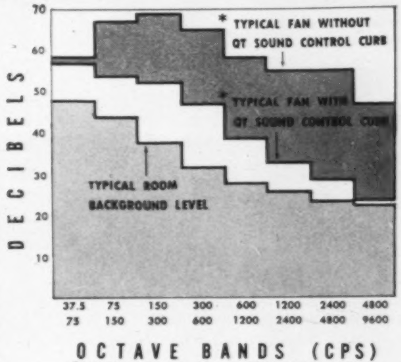
or selecting a SOUND CONTROL CURB it pays to be SURE!

1. **Be sure that performance data has been authenticated**
2. **Be sure that the design is original and not bootlegged**
3. **Be sure that you are not accepting a hastily copied, low quality substitute**
4. **Be sure that rights to produce and use are clearly established by patent and copyright laws**

The famous admonition, *caveat emptor* ("let the buyer beware"), is well worth calling to mind when it comes to selecting a sound attenuating curb for your power exhausters. Since performance cannot be judged visually, extreme caution is your best insurance against disappointing results.

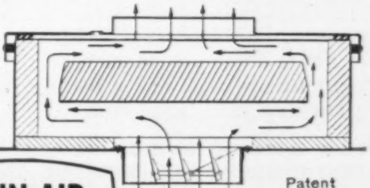
Consider these facts: Jenn-Air's QT Sound Control Curb is the first curb that *effectively* reduces fan noise. This major breakthrough in design provides twice as much attenuation as any previous so-called sound curb. The QT Sound Control Curb reduces exhauster sound power at inlet by 90% . . . with only a 10% loss in air moving capacity! These are actual performance figures—verified by independent laboratory tests.

Get all the facts before you specify—you'll find the Jenn-Air QT Sound Control Curb to be the genuine article. Write for Bulletin 601-SC.



*MODEL 100 CR, ⅓ HP, 1725 RPM MOTOR

EXCLUSIVE JENN-AIR DESIGN
Cross Section QT Sound Control Curb

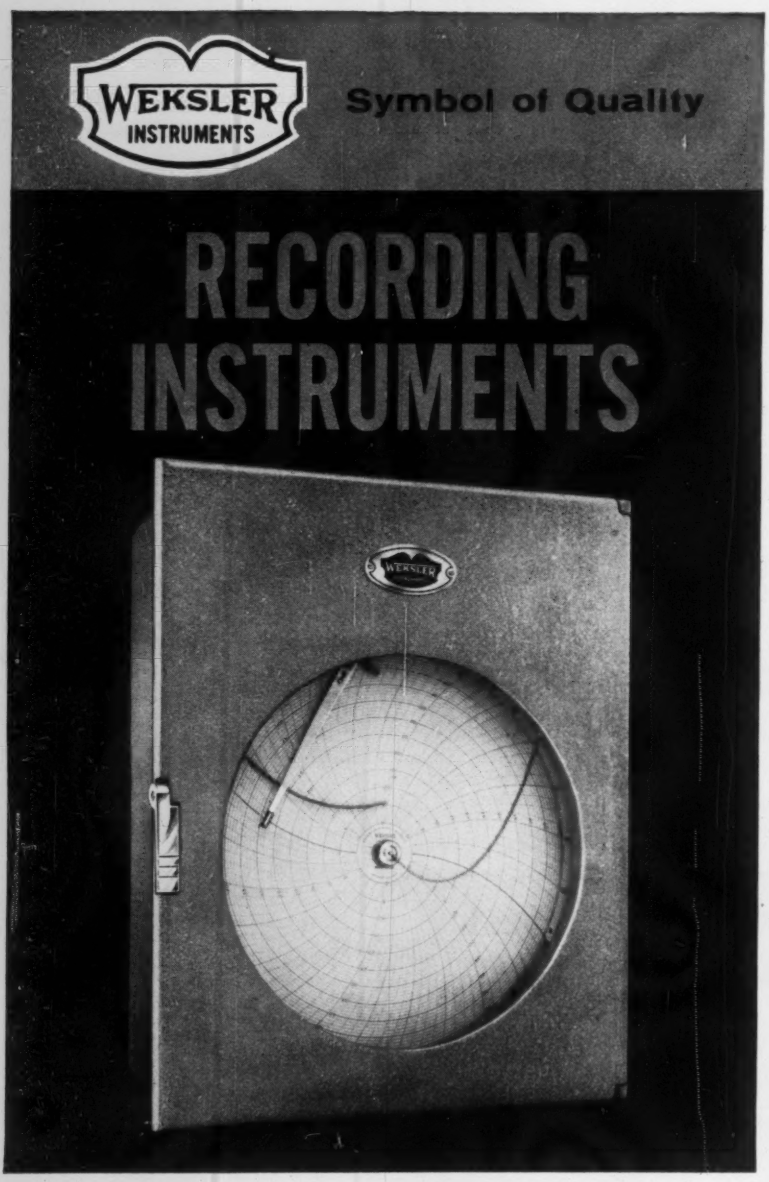


Patent Pending

JENN-AIR

QT
SOUND CONTROL CURB

JENN-AIR PRODUCTS COMPANY, INC. • 1102 STADIUM DRIVE • INDIANAPOLIS 7, INDIANA



YOU NAME IT! There are dozens of variables in size, style, application, mounting, chart range, actuation, manual or electric drive, tubing lengths, and pen systems.

One thing is sure. Weksler engineered recording instruments for temperature, pressure, humidity, and time-of-operation will meet every requirement. You name it! We'll produce it... but good!

NEW CATALOG OF COMPLETELY REDESIGNED WEKSLER RECORDING INSTRUMENTS WILL BE SENT ON REQUEST. WRITE FOR YOUR COPY.

WEKSLER INSTRUMENTS
"ORIGINATORS OF WORLD RENOWNED ADJUST-ANGLE THERMOMETERS"

WEKSLER INSTRUMENTS
CORPORATION
195 EAST MERRICK ROAD, FREEPORT, L. I., N. Y.
Indicating, Recording, and Controlling Instruments for Temperature, Pressure and Humidity

you'll want to know

Continued from page 230

1954	341,860,000
1955	390,390,000
1956	537,410,000
1957	604,730,000
1958	640,130,000
1959	716,570,000
1960	800,810,000

The ARI pointed out that these large systems, which gave most Americans their first taste of air conditioning, still account for the largest share of the industry's sales. And since less than 10 percent of all factories are air conditioned, there is a great potential in the industrial field, ARI noted.

MCAA Names John T. McCann as Executive Vice President

John T. McCann has been named executive vice president of the Mechanical Contractors Association of America, Inc. He succeeds Thomas J. Ryan, who died in the New York air disaster last December.

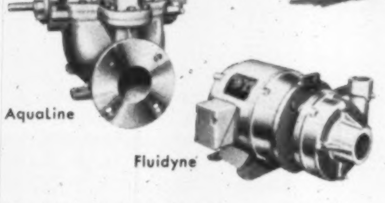
Mr. McCann assumed his duties

Continued on page 234

THESE QUALITY PUMPS CUT COSTLY SERVICE CALLS

PEERLESS PUMPS

PEERLESS END SUCTION AND SIDE SUCTION AIR CONDITIONING PUMPS COST LESS—LAST LONGER



PEERLESS AQUALINE® Pumps are available in sizes to 8-inches. Capacities to 2600 gpm, heads to 280 feet. Temperatures to 250°F. Horizontal split case design allows quick inspection without disturbing piping.

PEERLESS FLUIDYNE® Pumps are compact end-suction design. Redi-Packed in 22 sizes from 1 x 2 x 6 to 2½ x 3 x 10, for immediate shipment. Heads to 230 feet, capacities to 300 gpm, motors from 1 to 15 hp.

If there is a key word to describe Peerless Pumps, that word is QUALITY. You'll find it in the way the pumps are designed. You'll find it in the way the pumps are made. And you'll find it most apparent in the way these pumps operate. Remarkably long trouble-free operating records are routine with these better-made pumps.

But QUALITY is just the start of a long list of important features that recommend the Peerless AquaLine and Fluidyne line of pumps for your water handling jobs. There's immediate availability from ready-to-ship stocks. Complete hydraulic coverage for every type of application. Compact streamlined design that gives you space-saving good-looking layouts. And fast, on-time service from a network of warehouses and field offices. Get the full story of these superior pumps. Request more information today.

ATTENTION DEALERS: A limited number of Peerless AquaLine and Fluidyne pump dealerships are available. Please write for complete information.

Putting Ideas to Work

fmc
FOOD MACHINERY AND CHEMICAL CORPORATION

Peerless Pump
HYDRODYNAMICS ®DIVISION

Offices:
New York; Detroit; Cleveland; Chicago; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.
Distributors in principal cities.
Consult your telephone directory.

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2005 Northwestern Avenue, Indianapolis 8, Indiana
Gentlemen: Please send me immediately:
☐ Bulletin B-2319 on Peerless Fluidyne Pumps.
☐ Bulletin B-2100 on Peerless Aqualine Pumps.
☐ Name and address of nearest Peerless Dealer.

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Address____________________
City____________________
State____________________

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Install Insulation with

TUFF-BOND

Super-Strength Adhesives

TUFF-BOND #7
. . . fire-retardant adhesive for installing insulation

TUFF-BOND M-102-H
. . . duct liner adhesive

TUFF-BOND 21-C
. . . clear lap sealer and lap adhesive

TUFF-BOND 21-W
. . . white lap sealer and lap adhesive

TUFF-BOND #6
. . . non-flammable fire-retardant duct liner adhesive; meets Interim Federal Standard #00136.

TUFF-BOND #9
. . . for bonding rigid and semi-rigid plastic foams (polystyrene, urethane, isocyanate, etc.) to themselves and to other materials.

TUFF-BOND #12
. . . high pressure duct sealer

TUFF-BOND QUIK SET
. . . neoprene-base, fast-setting adhesive. Recommended for installing metal and nylon hangers to smooth surfaces.

TUFF-BOND GENERAL PURPOSE IMPROVED
. . . all-around adhesive for installing insulation, insulation hangers, etc.

Ask for literature and prices.

GOODLOE E. MOORE
INCORPORATED
DANVILLE 26, ILLINOIS

you'll want to know

Continued from page 232

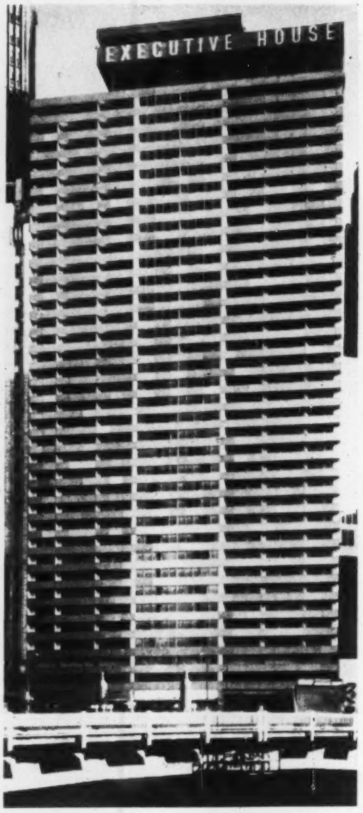
as the association's chief administrative officer and as advisor on legislation and labor relations with an impressive background. His experience includes union-management relations, contract negotiations, management training, and the practice of law. He has served on several Presidential Emergency Panels on labor problems and has been both Trial Examiner and Litigation Attorney for both the National and the New York State Labor Relations Boards.

Chicago Group Wants To Split ASHRAE's Illinois Chapter

A PETITION to organize a Chicago chapter of the American Society of Heating, Refrigerating and Air Conditioning Engineers is being circulated for signatures by a group of members of the society's Illinois chapter who belonged to the Chicago section of the American Society of Refrigerating Engineers prior to the merger of the two associations. Intent of the proposed new chapter would be to attract those members of the present Illinois chapter whose "primary interest is refrigeration." The geographical area would be the same for each chapter.

According to the petition, there has been a downward trend in attendance at meetings and in member interest in society affairs. Splitting into two chapters would mean "twice as many members working as officers, committee members, etc.," says the petition, and "more interesting and effective programming can be developed, with emphasis upon refrigeration."

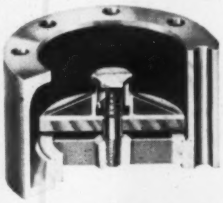
Continued on page 236



HOW TO CHECK A 4-TON "WHAM"

Two of the four CPV Silent Check Valves in Chicago's new Executive House stand beneath an 8-in. dia. column of water 40 stories high—and permit upward flow only without hammer or chatter. When the pumps shut off, these CPV silent checks close instantly and silently before the 4-ton fluid battering ram can "wham" the valves shut.

CPV stops water hammer by preventing it. That's why the truly SILENT CHECK VALVES are stamped CPV. Specify CPV and be sure.



For the full story and specifications, write for Catalog 600.

CPV

SILENT CHECK VALVES

COMBINATION PUMP VALVE COMPANY
851 Preston St. Philadelphia 4, Pa.

QUIET

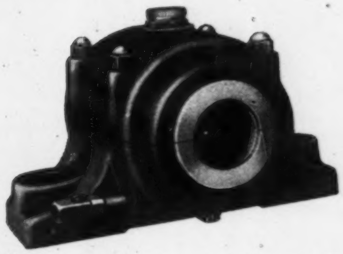
These quality bearings have been developed in close cooperation with manufacturers of fan and blower equipment — to meet the highly specialized requirements of this field.

The nation's great generating plants choose these bearings because of their extraordinary dependability—and the extreme quietness of their operation makes them top choice for air conditioning systems in hospitals, schools, theatres, auditoriums.

Dodge Fan and Blower Bearings are available from stock—with stock-product economy. Consult your local Dodge Distributor—or write us for technical data.

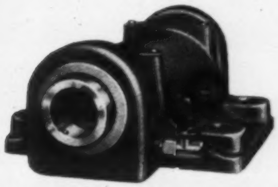
DODGE MANUFACTURING CORPORATION
1600 Union Street, Mishawaka, Indiana

DODGE
of Mishawaka, Ind.



DODGE SLEEVOIL PILLOW BLOCKS

Exceptionally quiet in operation. Noted for superb quality. Plain and Water Cooled Types. Precision-built, ring-oiling, babbitted. Self-aligning. Can be drilled for thermostatic emergency warning. Shaft sizes from 1-7/16" to 12".



DODGE BRONZE BUSHED PILLOW BLOCKS

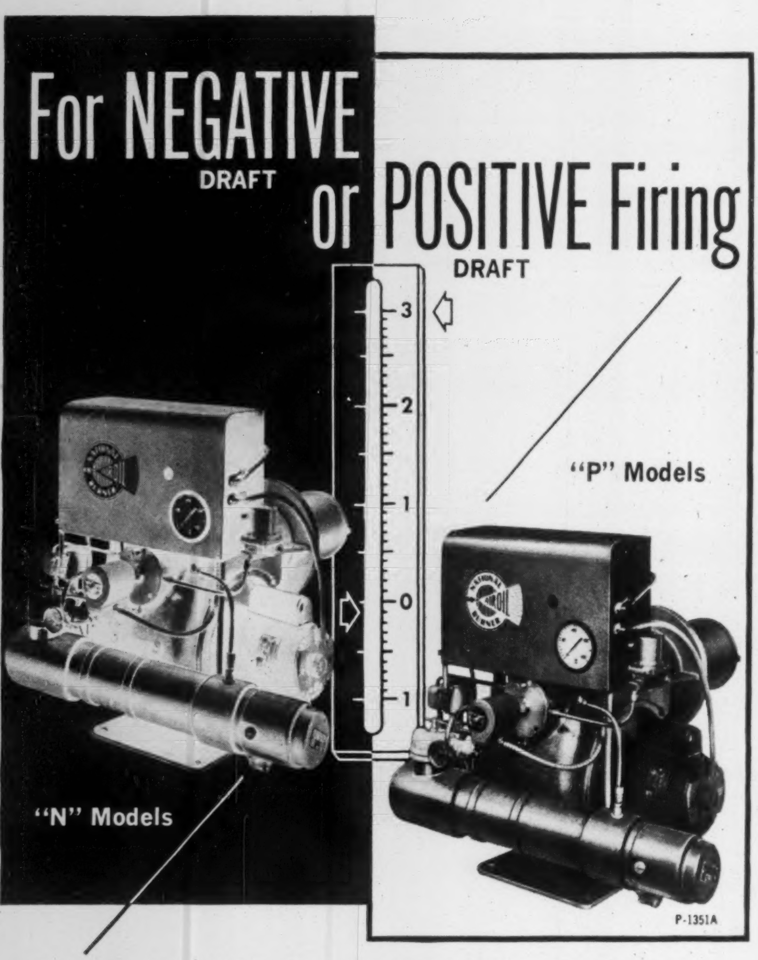
Designed for Arrangement No. 2 installations. Two bronze bushings of high lead content mounted in one cast iron housing. Special T-section rings for dependable lubrication. Exceptionally quiet in operation. Shaft sizes from 15/16" to 2-3/16".

DODGE BALL BEARING PILLOW BLOCKS

Designed for Arrangement No. 2 installations. Two precision single row, deep groove ball bearings in one cast iron housing. Extended inner race carries shaft. Remarkable ease of installation and maintenance. Shaft sizes from 15/16" to 2-3/16".

MANUFACTURER OF AMERICA'S MOST COMPLETE LINE OF MOUNTED BEARINGS

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the white pages of your telephone directory, or in the yellow pages under "Power Transmission Equipment."



Specify National Airoil Burners

Whatever your draft requirements . . . negative or positive . . . natural or induced draft, forced draft "pressurized" . . . there are TWO National Airoil **job-engineered** burners in 14 models available for top performance under the most severe service operations.

Select **TYPE C-45** for burning **Numbers 4 and 5** commercial fuel oils . . . **"N"** models operate with a **negative** draft of 0.05″ w.c. to 21 gph, 0.075″ w.c. to 33 gph . . . **"P"** models operate against a **positive** furnace pressure up to 3″ w.c. . . quiet, easy to install, high temperature flame, excellent combustion, simple, sturdy construction, thoroughly field-tested and proved. Bulletin 100A.

Select **TYPE C-20,** a companion to the C-45 shown above, for burning the lighter **Number 2** fuel oil . . . **"N"** models operate with a **negative** draft of 0.05″ w.c. to 21 gph, 0.075″ w.c. to 33 gph . . . **"P"** models operate against a **positive** furnace pressure up to 3″ w.c. . . . clean, pulsation-free operation. Bulletin 102.

These Underwriter-approved **packaged** burners offer many outstanding first-time features. Data is contained in our comprehensive literature and specifications. Just tell us your needs and you'll hear from us by return mail.

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NATIONAL AIROIL BURNER COMPANY, INC.
1284 E. Sedgley Avenue • Philadelphia 34, Pa., U.S.A.
Industrial Oil Burners, Gas Burners and Combustion Equipment

you'll want to know

Continued from page 234

Samuel R. Lewis Asks for Referendum On ASHRAE Laboratory

At the April meeting of the Illinois Chapter of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Samuel R. Lewis, consulting engineer and past president of the American Society of Heating and Ventilating Engineers, stated the following:

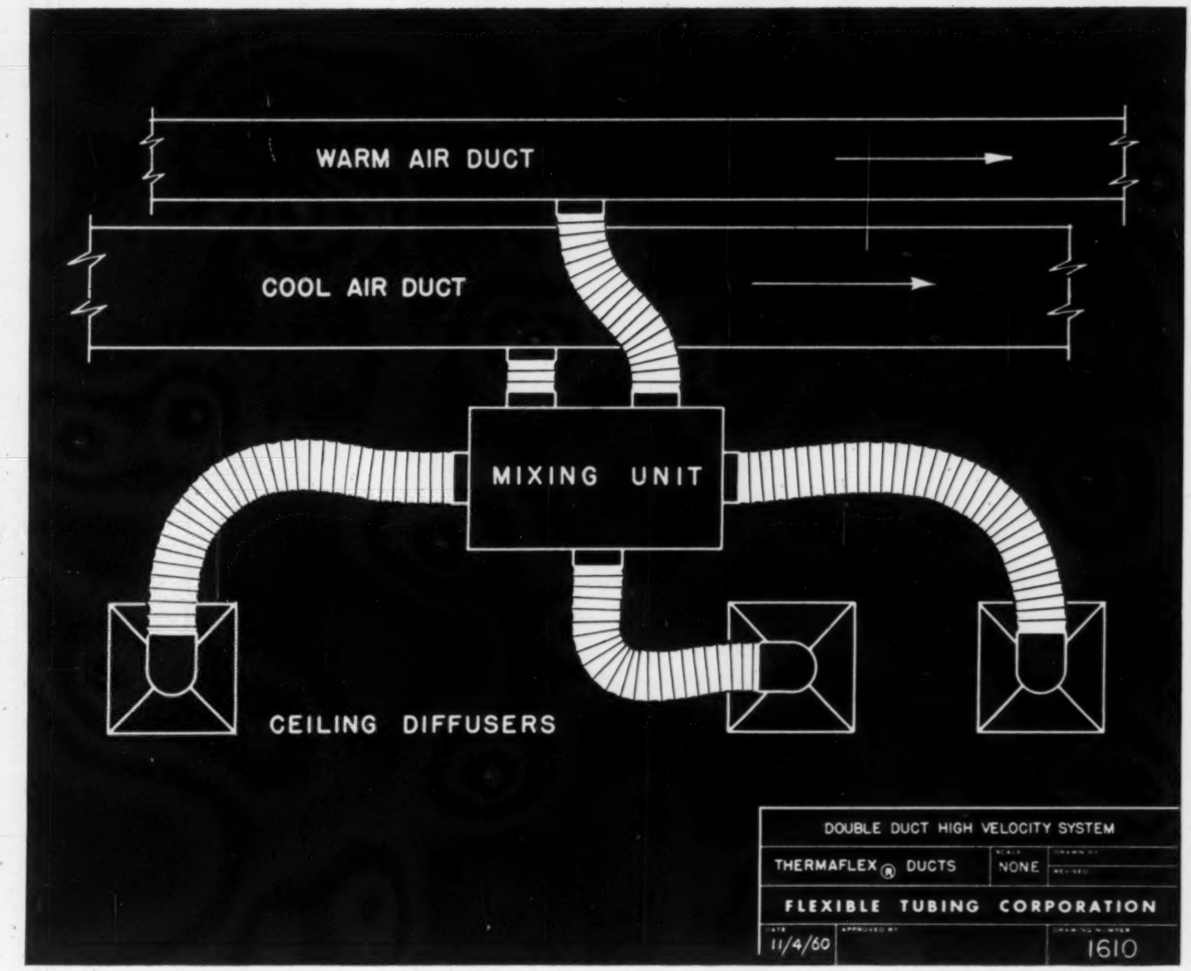
"During the annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers in February, 1961, it was disclosed that the administration of the newly merged Society summarily had discontinued the ASHRAE Research Laboratory in Cleveland. This discontinuation of the long-established research by the merged Society brought about serious disappointment in the minds of a great many of the members of the former ASHAE, because the research activities were of great value.

"The reactions seem to indicate that this move by the officers of the merged Society in dispensing with the laboratory was unfortunate, and like several other drastic changes in administration by the merged Society, could bring about unrest and reduced devotion by many of the ASHRAE members.

"It is important that unified loyalty by all of the members of the merged Society should be manifest. Engineers should in all reasonable faith take time to improve communication between members and to be assured that the wishes of the majority of the members shall be expressed.

"I move that the Illinois Chapter shall request from the National

Continued on page 239


WARM AIR DUCT
COOL AIR DUCT
MIXING UNIT
CEILING DIFFUSERS
DOUBLE DUCT HIGH VELOCITY SYSTEM
THERMAFLEX® DUCTS
NONE
FLEXIBLE TUBING CORPORATION
11/4/60
1610

In the double-duct high velocity system...

Flexible Tubing simplifies connections to mixing units, diffusers...gives you greater design flexibility

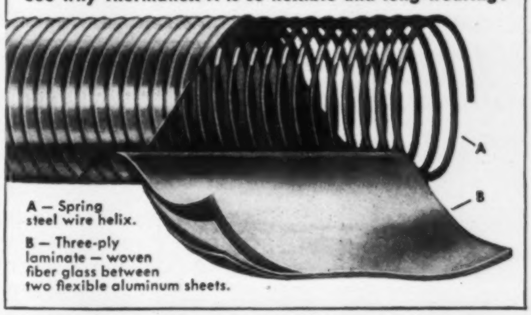
Flexible Tubing is the fast, easy way to connect supply ducts to both mixing units and diffusers. It's particularly helpful in systems that require multiple run-outs.

This highly flexible duct is constructed of a rugged cover permanently bonded to a rustproof spring wire helix. It's ideal for installations where changing space requirements will mean periodic relocation of partitions. Flexible Tubing permits diffusers to be moved *without being disconnected* — the ductwork simply trails behind!

Flexible Tubing goes around obstructions and through tight passages in gradual bends with minimum air friction. It greatly reduces noises and vibration . . . corrects for misalignment at points of take-off. Lightweight, flameproof, easy to install.

Specify Thermaflex® for the next system *you* design. For complete product data on Underwriters'-approved Thermaflex, write Flexible Tubing Corporation, 55 New Whitfield Street, Guilford, Connecticut.

See why Thermaflex-A is so flexible and long-wearing!


A
B
A — Spring steel wire helix.
B — Three-ply laminate — woven fiber glass between two flexible aluminum sheets.

Flexible Tubing
CORPORATION
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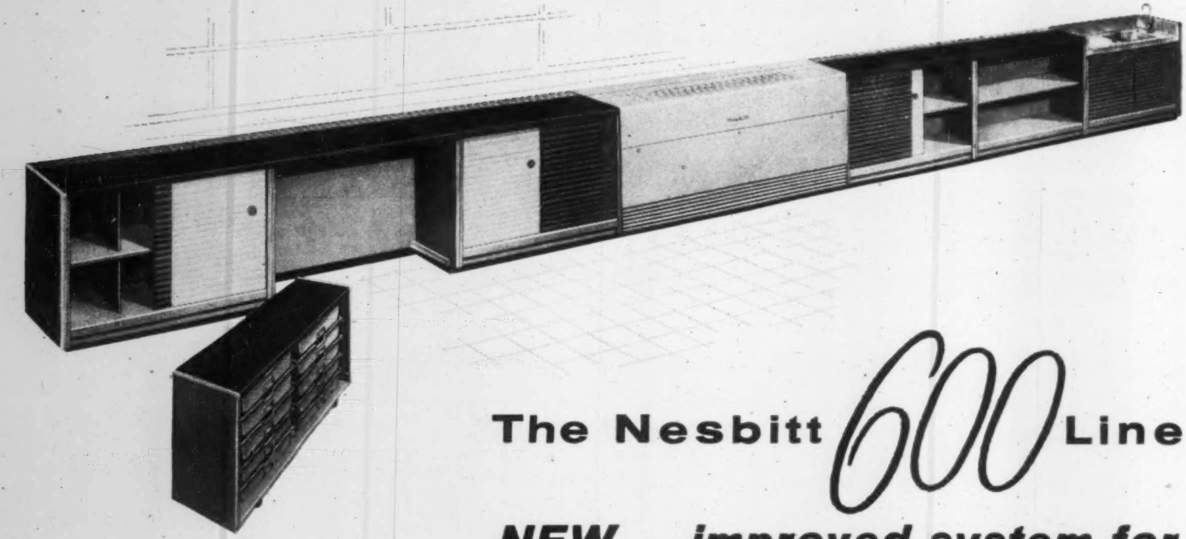
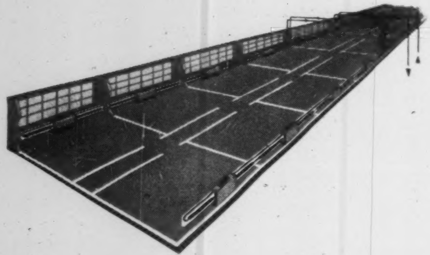


The Nesbitt 600 Line

NEW... improved system for classroom comfort and economy



Wind-o-line Radiation makes the difference!

This new engineering publication for the Series 600 Line is now ready. Write for a copy of Pub. 10A1.

Of course you like the beauty of modern lines and colors . . . and you welcome the fact that these new integrated storage cabinets provide the mobility and flexibility demanded by creative teachers . . . but of prime importance to *you*, as a designer for classroom thermal comfort, is the fact that the features and advantages of Wind-o-line Radiation have been retained in the new Nesbitt Series 600 Line.

Wind-o-line solves the cold downdraft problem . . . but more than that: In a forced hot water system the copper tubing of Wind-o-line finned radiation serves as the supply and return piping for the Syncretizer unit ventilators in a whole group of classrooms. Costly pipe trenches, conventional mains, run-outs and pipe coverings are eliminated.

Syncretizer multiple serpentine heating elements deliver the required heating capacity with water quantities a third or less of those demanded by conventional elements; and the additional heating surface provided by Wind-o-line further reduces the water quantity. Smaller pipes and pumps are used.

The gravity heating capacity of the Syncretizer with Wind-o-line radiation is more than sufficient to maintain adequate building temperatures during shutdown periods. Special controls and intermittent fan operation are unnecessary.

Thus, for daytime comfort, nighttime protection, and *reduced system costs*—WIND-O-LINE MAKES THE DIFFERENCE!

"For the Pursuit of Scholastic Excellence"

Nesbitt COMFORT-CONDITIONED CLASSROOMS

The Series 600 Line is made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa.
Sold also by American-Standard Industrial Division, and American-Standard Products (Canada) Ltd.

INSULATION INSTALLED FAST

WITH

MIRACLE SURFACE ANCHORS

Use Miracle Surface Anchors, bonded with Miracle Anchor Adhesives, to provide firm support for block, board, or blanket type insulation. Eliminates drilling and welding. You save man hours, cut costs way down.

Use Spindle Anchors for bonding fibrous glass batts, mineral wool to ducts, walls, ceilings. Lock washer holds insulation firmly in place.

Use Pronged Anchors for bonding block insulation such as cellular glass. Pronged Anchors are set between rows of blocks and then prongs are bent over.

FREE

Valuable, informative engineers and architects bulletins giving details and complete specification data. Yours on request.

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you'll want to know

Continued from page 236

Administration of the ASHRAE, a written referendum, by all members of the Society, as to whether the ASHRAE should continue to encourage and conduct in its own controlled laboratory, scientific research, and the study of principles and methods in the fields of heating, refrigeration, air conditioning, and ventilation."

The action requested by Mr. Lewis was passed by a vote of the members present, 46 to 11.

Plan Underground Piping System for Cooling, River Pollution Control

Construction of a large underground piping system is now under way that will serve the dual purpose of supplying cooling water for five industrial plants and reducing the pollution problem of the Buffalo River.

The system will have the capacity to deliver 200 million gallons of water each day from Lake Erie to the five plants in Buffalo, N.Y. The water will be used for cooling purposes only before it is emptied into the river.

The project is being undertaken by the city of Buffalo, which is putting up its credit to construct the system, and the Buffalo River Improvement Corp. The latter is composed of the National Aniline and General Chemical divisions of the Allied Chemical Corp., Republic Steel Corp., Donner-Hanna Coke Corp., and Socony-Mobil Oil Co., Inc.

When the project is completed by the city, the corporation will lease the facility for 30 years and the five plants have agreed to purchase 101 million gallons of water daily from the corporation. The payments for water will amortize the cost of the project at no expense to the taxpayers. At the end of the amortization period,

AirMaster

LO-BOY
CENTRIFUGAL
ROOF EXHAUSTERS

Enhance the Beauty of Building Skylines

Pats. Pend.

Lowest Silhouette Design

Forward or Backward Curve Wheel Within . . . . or Out of Scroll Housing

Motor mounting on side of structure support . . . out of line of air stream reduces height of Lo-Boy models nearly 50% of older designs.

LOW WIND RESISTANCE
SIZES 10"-72" 600-47,000
CERTIFIED C.F.M. RATINGS

- QUALITY • BEAUTY
- PROVEN PERFORMANCE

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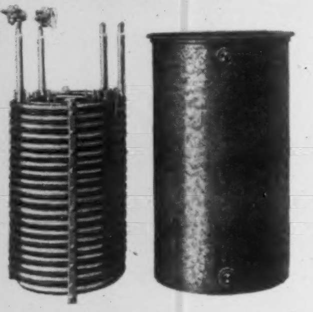
AMMERMAN CO., INC.
P.O. Box 182
Stillwater, Minnesota
MEMBER OF THE AIR MOVING & CONDITIONING ASSN.

REMPE

Heat Transfer Equipment

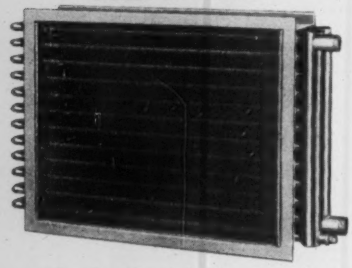
TANK and COIL ASSEMBLIES



For Sub-Zero or High Temperatures

One of many Rempe Coil jobs: This Tank and Coil assembly was built for use with thermostatic expansion valves to dewax oil at minus 35° F. Any diameter or any length to your specifications or our design. Can be supplied in Steel, Alloy, Stainless Steel, Copper or Aluminum.

STEAM BLEED HEATERS



For Residential, Commercial or Industrial Applications

This is the popular Rempe Hi-Cap line of heating coils. Equipped with the exclusive "Defrost-Tap" to keep coil warm during steam off-cycle and prevent freeze-up.
Single or double row designs available . . . any face area desired.
Eight, collared, Aluminum fins per inch on copper tube. Heavy steel casings.

Engineering Data Book

Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

REMPE COMPANY

342 N. Sacramento Blvd. • Chicago 12, Ill.

you'll want to know

Continued from page 239

the city will own a cost-free, revenue-producing facility.

The system is expected to be completed by the end of 1962. More engineering details are now being assembled for an article to be published in a future issue of Heating, Piping & Air Conditioning. The design and installation features will be explained in this article.

McFarland - Johnson are the consulting engineers for this project.

System Developed for Figuring Economic Thickness Of Thermal Installation

A PRACTICAL MEANS for specifying the exact thickness of thermal insulation needed for maximum economy has been achieved by engineers at the Union Carbide Chemicals Co. in cooperation with the College of Engineering, West Virginia University.

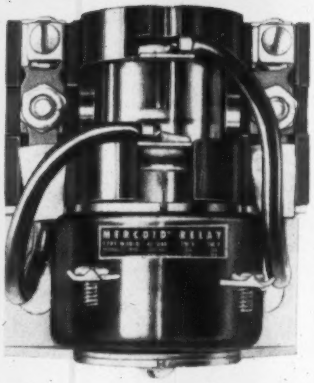
The new system is based on the basic equations for the calculation of economic thickness of insulation that were worked out as far back as 1926 by L. B. McMillan. What the research team accomplished was to combine the variables involved in heat cost and insulation cost into a single "D" factor, and then make a new formula workable by means of a series of four sets of charts Twenty-two pipe sizes, ½ to 36 in., and flat surfaces, temperature differences ranging from 90 to 1314 F, and insulation conductivities from 0.10 to 1.5 are covered in the tabulations.

The 182 page manual, "Economic Thickness of Insulation for Flat Surfaces and Pipes," will be distributed by the National Insulation Manufacturers Association, 441 Lexington Ave., New York 17. To be available June 15, the manual will cost $10 per copy.

35 AMP

Plunger Type

MERCOID MERCURY RELAY



If you need reliability and durability, this quality built relay by Mercoid is your answer.
For heavy duty loads, such as resistance heating, (domestic, commercial, industrial)—heat treating furnaces, drying equipment, welding, lighting, illuminated signs, score boards.
Hermetically sealed mercury to mercury contact provides visible on-off operation. Silent and chatterless. Quickly mounted, easily wired. Speeds up to 100 operations per minute.

CONTACT RATING

LOAD			NON INDUCTIVE HEATER LOADS	
	AC	DC	AC ONLY	
120V.	30A.	15A.	120V.	35A.
240V.	20A.	10A.	240V.	25A.
440V.	8A.	—	440V.	10A.

WRITE FOR BULLETIN 0-20

THE MERCOID CORPORATION,

4209 Belmont Ave.,
Chicago 41, Ill.

RECENT TRADE LITERATURE . . .

Direct-Fired Immersion Heaters

Four page Bulletin 410 describes units for heating asphalt, Bunker "C" oil, and other liquids in tanks for loading, pumping, blending, or storage. Fired by oil or gas. Table of dimensions and specifications given on two standard sizes with capacities to 1,250,000 Btu per hr, and higher with multiple units. Auxiliary equipment and method of operation and installation described. — *Brown Fintube Co., 300 Huron St., Elyria, O.*

Centrifugal Roof Ventilator

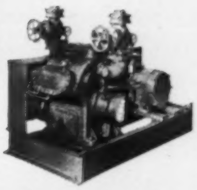
Eight page Bulletin 4104 describes model "CRD" direct drive centrifugal roof ventilator. Selection and ratings tables indicate relative quietness ratings, motor hp, fan speeds, and fan deliveries for different static pressure conditions. Operating characteristics are discussed. Installation type drawings correlated with tabular data for use in layouts. Typical specifications are provided. — *American-Standard Industrial Div., Detroit 32.*

Centrifugal Turbine Pumps

Thirty-six page booklet, C101, describes regenerative centrifugal turbine pumps of end-mounted industrial design. Contains 84 performance curves and calculations. Also includes seven "family" curves for quick identification of the performance relationship between models of a given series. Covers motor selection, NPSH calculation, specific gravity conversion, and viscosity conversion. — *Roy E. Roth Co., Turbine Pump Div., Rock Island, Ill.*

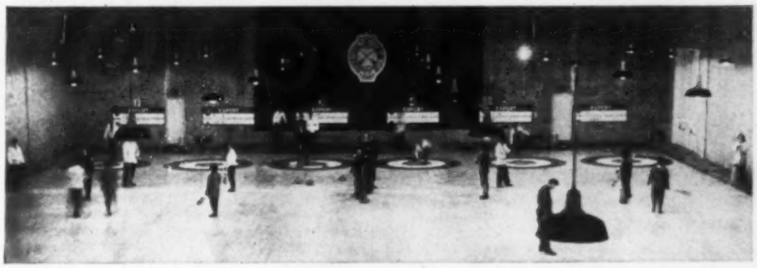
Summer Cooling... Winter Curling and Skating - all with ONE refrigeration system

Main entrance to Prudhomme's Garden Centre Motor Hotel in Vineland, Ontario. This exciting summer and winter playground spot uses Vilter refrigeration to good advantage.



Two 6-cyl. Vilter VMC belt-driven compressors provide refrigeration at Prudhomme's for summer air conditioning and winter curling.

The Garden Centre Theatre becomes a regulation six-sheet curling rink during the winter months. The Vilter system is designed to produce ideal curling ice at the lowest possible power cost.



Year 'round use of your refrigeration capacity is sound business and enables maximum profit to be realized from your investment.

An excellent example of the year-'round utilization of refrigeration is Prudhomme's Garden Centre Motor Hotel in Vineland, Ontario, along the Queen Elizabeth Way. At this famous motel, recreation center and convention headquarters, Vilter refrigeration plays an important role in keeping guests happy.

During the summer months, refrigeration is required to air condition the 180-room motel, one of Canada's largest, and an 1100-seat summer stock theatre which draws large crowds to see outstanding stock productions of Broadway plays. In winter months, the same equipment builds ice surfaces for a 90′ x 180′ outdoor ice skating rink and a regulation six-sheet curling rink. The summer stock theatre building is used to house the curling rink with either a seating structure installed or plastic piping laid for the curling rink, depending upon the season.

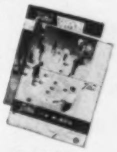
Vilter equipment installed at Prudhomme's includes two 6-cylinder VMC compressors and a 24″ x 20′ shell and tube condenser.

Vilter has had many years of experience in recommending and building refrigeration systems for air conditioning and ice rinks. This know-how, plus the use of dependable economical-to-operate Vilter equipment, can also mean a satisfying installation for you. Why not see your nearest Vilter representative today?

Sold and Installed by VILTER DISTRIBUTOR
J. L. Wilson and Sons, Limited, Toronto, Ontario, Canada

Vilter®
refrigeration
air conditioning

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin
Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.

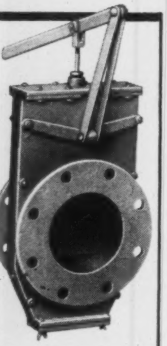


Write for helpful bulletins to
The Vilter Manufacturing Company, Dept. F-614
2217 South First Street
Milwaukee 7, Wisconsin

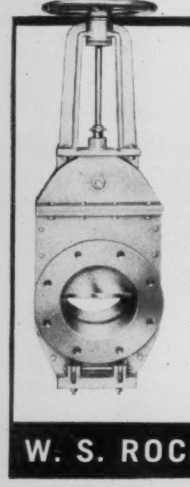
ROCKWELL
SLIDE VALVES

for GASES
SLURRIES OR FREE-FLOWING SOLIDS
THAT CLOG OR JAM
OTHER VALVES...

Standard Slide Valve, screwed end type or flanged (shown); when fully open, valve offers no restriction to fluid flow. Bulletin 500R.



"Kwikleen" Slide Valve — Not necessary to remove from line for cleaning. Sediment discharged at bottom. Complete cleanout by attaching steam, water or air line to plug hole in valve body. Bulletin 501R.



Heavy Duty "Kwikleen" Valve for line pressures to 60 psi. Blade not exposed when in fully open position. Ideal for pulp stock, slurries, dust, fly ash, scale, granular materials. Bulletin 508.

W. S. ROCKWELL CO.

2700 Eliot St., Fairfield, Conn.

RECENT TRADE LITERATURE

Continued

Glass Fiber Air Duct

Twelve page specifications bulletin for "Armaglas" duct for heating and air conditioning systems. Round prefabricated duct molded from fine glass fibers; has a factory applied airtight aluminum pigmented polyvinyl chloride casing. Suitable for handling cooled air to an upper limit of 250 F. Withstands internal static pressures up to 1½ in. water when handling air up to 250 F at velocities of 1500 ft per min. Contains specifications for engineers and installation instructions for contractors. Lists complete properties. Illustrated with charts and photos. — *Armstrong Cork Co., Lancaster, Pa.*

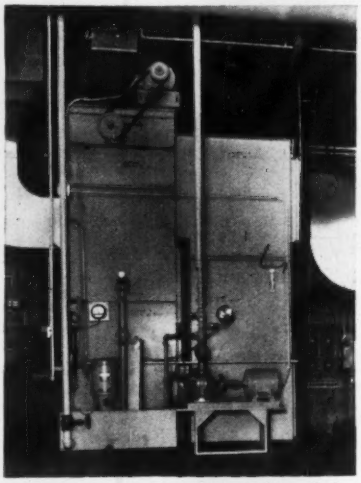
Dry-Type Air Filter

Eight page Bulletin 228 describes unit that inflates when ventilation system is in operation and deflates when system is shut down. Gives data on application, construction, installation, operation, and holding frame arrangements. Includes dimensional drawings, performances data, space requirements, and suggested specifications. — *American Air Filter Co., Inc.,* 215 *Central Ave., Louisville* 8, *Ky.*

Air Conditioning Maintenance

One page Bulletin T-51 gives suggestions for start up procedures and operational practices of water cooled air conditioning systems. Suggestions pertain to the areas affected by circulating water and are in addition to mechanical maintenance such as motor lubrication, fan operation, refrigerants, etc. — *Associated Laboratories, Inc.,* 26845 *Southfield Rd., Lathrup Village, Mich.*

PRECISE
Air Conditioning



The NIAGARA Liquid Absorbent Method

removes atmospheric moisture by direct contact with an absorbent liquid in a compact spray chamber. The spray contact temperature and the concentration of the absorbent liquid, two factors that are easily controlled, determine precisely how much moisture remains in the air leaving the unit.

This Niagara Controlled Humidity method, using Niagara Hygrol Absorbent Liquid is....

The only really precise method of air conditioning because it removes moisture as a separate function from heating or cooling to give you assurance of accuracy of air moisture control.

It is the most reliable because the absorbent is continuously and automatically kept at the proper concentration. No moisture-sensitive instruments are required to control your conditions.

It is the most flexible because with it you can either hold the precise condition you need as long as you wish or vary it with accuracy.

It is easiest to operate and maintain because the equipment and controls are simple and trustworthy.

This method is successfully used in the storage, testing and production of hygroscopic materials, in process control and as a pre-dehumidifier in comfort air conditioning.

Write for Bulletin Nos. 120 and 140.

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N. Y.
HP-5 Niagara District Engineers
in Principal Cities of U. S. and Canada

RECENT TRADE LITERATURE
Continued

Package Liquid Coolers

Several bulletins describe package liquid coolers ranging from 7½ to 150 ton capacities. Standard and optional mechanical specifications are listed. Dimensions, physical data, and sample specifications also given. Ratings listed in tabular form. Illustrated with photos, line drawings, and charts. — *Bell & Gossett Co., 8200 N. Austin Ave., Morton Grove, Ill.*

High Velocity Valve Attenuators

Four page Bulletin K-52 describes "Series 45P Pneumavalve" total constant volume high velocity valve attenuators. Includes ceiling and under-window units. Gives sizes, capacities, selection and performance data, dimensions, specifications, and ratings. Operation is discussed in detail and is illustrated by a series of diagrams. — *Connor Engineering Corp., Danbury, Conn.*

Temperature Control Centers

Eight page bulletin, F-8031-1, describes automatic temperature control centers for commercial and industrial buildings. Discusses remote temperature indication, recording, and control point adjustment by electric and electronic instruments. Includes a check list for control center planning. Illustrated with photos of components. — *Barber-Colman Co., 1300 Rock St., Rockford, Ill.*

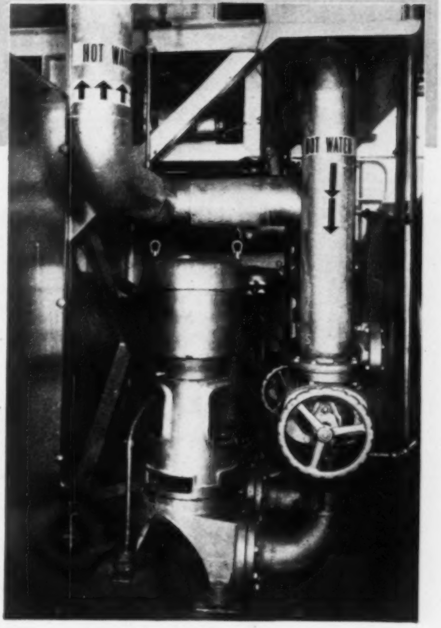
Fans, Ventilators, Unit Heaters

Eight page Bulletin DB7-102 describes direct-connected airfoil centrifugal fans; propeller and centrifugal power roof ventilators; wall-mounted and square panel propeller fans; and steam, hot water, electric, and gas-fired unit heaters. Contains illustrations, ratings, and specifications. — *Ilg Electric Ventilating Co., 2850 N. Pulaski Rd., Chicago 41.*

SPECIFY THE weil

VKY *Space Saving*

VERTICAL CIRCULATING PUMP



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CIRCULATING • HOT WATER FOR HEATING

CIRCULATING • CHILLED WATER FOR COOLING

CIRCULATING • CONDENSER WATER

BOOSTER • PUMP SERVICE

Capacities to • 750 GPM.

QUIET OPERATING
EFFICIENT PERFORMANCE

An all ball bearing pump designed for continuous operation!

THE weil VKY pump . . .

The highly efficient VKY PUMP requires only one shaft seal. Supply and discharge piping are on one side only. All operating parts may be removed without disturbing any piping connections. Motor is a standard frame NEMA C mount with standard shaft extension. Vibration is eliminated by three rubber vibration eliminator mounts. Noise transmission is reduced to an absolute minimum.

SEND FOR BULLETIN VKY-6900.

weil PUMP COMPANY

1514 N. Fremont Street, Chicago 22, Illinois

which size stack do YOU prefer?

Each does the same job— the smaller one is equipped with a Lehigh Induced Draft Fan

Lehigh Induced Draft Fans are designed to help eliminate large, costly, unsightly stacks. They maintain a *constant* over-fire draft regardless of atmospheric conditions, help keep boilers operating at *maximum* efficiently at all times, and significantly *lower fuel bills* . . . while radically *reducing* the size of your stack.

Rugged Construction—long life: to prevent distortion under elevated temperature conditions, the fan housing, bearing pedestal, motor support and fan wheel of Lehigh Draft Induced Fans are constructed of all-welded integral $\frac{3}{16}$" mild steel. A radiant heat cover and an aluminum heat flinger protect the inboard bearing from radiated heat. And because both bearing and shaft are kept to a low operating temperature, the Lehigh Induced Draft Fan makes use of standard, self-aligning ball bearing pillow blocks. *All* Lehigh Induced Draft Fans feature a flanged inlet, flanged outlet, and inspection cover as standard equipment.

If you would like to reduce stack height . . . and gain optimum boiler efficiency . . . contact your local Lehigh Representative today. He'll gladly give you all the details. Or write directly to us for our detailed technical bulletin:

2171
LF-1

LEHIGH FAN & BLOWER DIVISION
FULLER COMPANY, CATASAUQUA 1, PA.
Subsidiary of General American Transportation Corporation

RECENT TRADE LITERATURE

Continued

Classroom Heating

Six page bulletin explains the application of electric heating to firm's "Comfort Curtain" system of classroom heating. Explains how heat pump can be applied for both heating and air conditioning and the techniques for applying additive cooling. Information given on central electric furnaces, the "Landmark" electric furnace, electric duct heaters, bookcase duct, and wall duct types of classroom equipment. Capacities and performance data included. — *Lennox Industries Inc., Marshalltown, Ia.*

Arc Welding Products

Forty page bulletin "Weldirectory of Arc Welding Electrodes, Equipment, and Supplies" describes full line of arc welding products. Gives AWS electrode classifications. Discusses correct electrode selection for all welding applications. Includes data on arc characteristics, welding procedures, and physical properties of electrodes. Also features line of arc welders. — *The Lincoln Electric Co.,* 22801 *St. Clair Ave., Cleveland* 17.

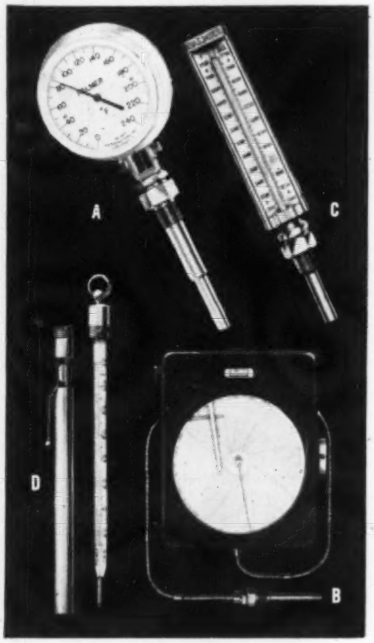
Hot Water Boiler

Bulletin 1275 describes hot water boiler with side located furnace that permits boiler feed injection and natural thermal circulation to augment each other. Hinged front and rear covers permit easy access. Features hinged dry back and optional wet back construction. Bulletin shows drawings of unit for low, medium, and high temperature applications. Gives sizes, ratings, dimensions, and approximate fuel consumption for each size. — *Orr & Sembower, Inc., P.O. Box* 1138, *Reading, Pa.*

A GREAT NAME IN THERMOMETERS

PALMER

Mercury Actuated
Temperature Indicating Instruments



A—4½" DIAL THERMOMETERS: Made in 3 types to suit any requirements. Rigid stem, wall or flush mounted, 11 inches of scale reading. Interchangeable with standard industrial separable sockets. Stem can be placed at any angle and case can be rotated to any readable position.

B—RECORDING THERMOMETERS: Twelve inch die-cast aluminum case with black finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges: −40 +950° F or Equivalent in °C.

C—INDUSTRIAL THERMOMETERS: Red-Reading Mercury—Extruded brass case—chrome finish. Ranges: −40 +950° or Equivalent in °C.

D—RED-READING MERCURY LABORATORY THERMOMETERS: Thoroughly annealed for permanent accuracy. Complete line A.S.T.M. and fractional division types.

FOR COMPLETE INFORMATION WRITE FOR CATALOG

PALMER

PALMER THERMOMETERS, INC.
Cincinnati 12, Ohio • MElrose 1 1500

RECENT TRADE LITERATURE

Continued

Valve Position Transmitter

Two page Bulletin 0285.20-1 describes pneumatic units for translating position into a proportional output pressure. Operates on the force balance principle. For either rotary or straight-line motion. Contains photos, dimensions, specifications, and application examples. — *B-I-F Industries, Inc., P.O. Box 276, Providence 1, R.I.*

Electronic Combustion Analyzer

Folder V588 describes portable unit that uses bead type thermistors which are unaffected by soot or foreign matter. Explains how analyzer works by measuring CO_2 content of flue gas, stack temperature, and draft over fire. Contains photos and diagrams. — *Victory Engineering Corp., 612 Springfield Rd., Union, N.J.*

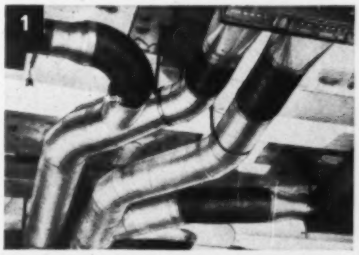
Residual Fuel Oil Treatment

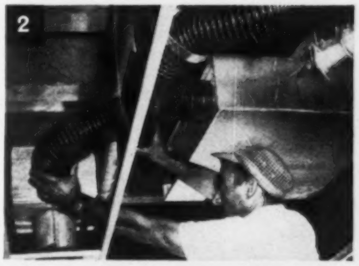
Two page Bulletin E1-159 describes residual fuel oil treatment for minimizing slag and corrosion in boiler systems. How product improves heat transfer and protects the convection and "cold end" of boiler is outlined. A case study and methods of application are included. — *Nalco Chemical Co., 6216 W. 66th Place, Chicago 38.*

Low Pressure Boilers

Eight page Bulletin 649B describes units available in 16 sizes ranging in capacity from 1,392,000 to 15,430,000 Btu per hr, SBI rating. Designed to develop 141.5 percent of this rating. Includes data on individual unit ratings and dimensions. Gives typical specifications and selection data. Also includes information for heating coils and induced draft fans. — *American-Standard Industrial Div., Detroit 32.*

which system is
HIGH VELOCITY?
MEDIUM VELOCITY?
LOW VELOCITY?





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WIREMOLD®
AIR DUCT

Rugged and flexible, Wiremold Air Duct is being used today wherever air conditioning systems are employed. Send for latest literature. Answer: (1) medium (2) high (3) low.

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WIREMOLD ■ HARTFORD 10, CONN.
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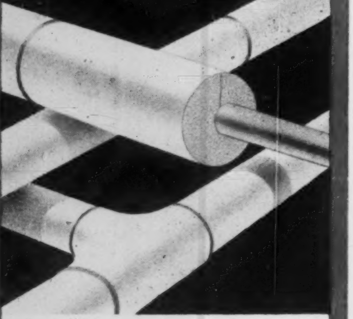
New CLAIR COAT

LAGGING ADHESIVE

CREATED FOR THE TOUGHEST PIPE AND DUCT LAGGING APPLICATIONS

A NEW AND EXCLUSIVE PRODUCT OF ST. CLAIR'S RESEARCH LABORATORIES



Note THESE 10 HIGH SCORING POINTS

- FAST SETTING
  Sets almost immediately for faster application.
- LOW FREEZING POINT
  and is usable after being frozen solid.
- NON-FLAMMABLE
  with fire retardant dried film
- STRONGEST PERMANENT BOND
  Proved by comparative tests.
- ONE COAT NEEDED
  for sleek, semi-gloss finish
- STEAM AND WATERPROOF
  by contractor's tests
- VERMIN-PROOF
- FINE APPEARANCE
  with long-lasting protection
- EASILY WASHABLE
- NON-TOXIC
  and will not settle in container

Write for literature - samples - prices.

ST. CLAIR RUBBER CO.
Empire Bldg.
107 Clifford St. Detroit 26, Mich.

RECENT TRADE LITERATURE

Continued

Air Conditioning Control Valves

Eight page Bulletin 272-A describes "Selectaflow" dual-purpose year 'round air conditioning control valves. Valves for application with systems using hot or cold water with a single supply line and a single return line. Gives specifications on both direct and remote actuator types available. Heating cycle and cooling cycle operations illustrated by cross-sectional schematic diagrams. — *American-Standard Controls Div.*, 5900 *Trumbull Ave., Detroit* 8, *Mich.*

Masonry Fastener

Four page leaflet describes one-piece nail-anchor available in aluminum and steel. Sizes from 3/16 × 7/8 in. to ¼ × 1½ in. Requires only a drill and a hammer for installation. Photos and drawings give installation instructions. — *The Rawlplug Co., Inc., New Rochelle, N.Y.*

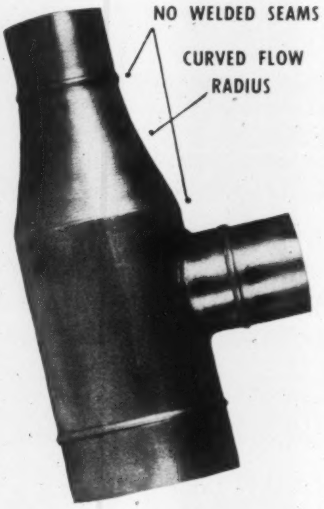
Centrifugal Pump Ball Bearings

Technical information bulletin, number six, describes ball bearings for centrifugal pumps in deep groove, maximum capacity, and angular contact designs. Cites problems of axial and radial thrust. Gives a comparative analysis of the single row versus the double row bearing. Bearing replacement is discussed. Five basic points for installation into centrifugal pumps are given. — *Peerless Pump, Hydrodynamics Div.*, 301 *W. Ave.* 26, *Los Angeles* 31.

Automatic Dust Collector

Folder describes 11 models of dust collector made possible by modular design. Dimensions and filter areas detailed in a table. Schematic drawing and legend explain unit's operation. Includes photos. — *Torit Manufacturing Co., Automatic Collector Div.*, 1131 *Rankin St., St. Paul* 16, *Minn.*

ANNOUNCING MACHINE-FORMED FITTINGS for HIGH VELOCITY air systems



- LOWER COST
- EASIER INSTALLATION
- GUARANTEED QUALITY

UP TO 50% COST REDUCTION

United's new mass-produced machine-made fittings can reduce fitting costs up to 50% . . . and provide the air movement industry with a standardized fitting having uniformity of performance, factory controlled quality and dimensions. Please note — these fittings are specifically sized to fit United Spiral "Lockseam" pipe. Contact your local United representative for complete information.

spiral pipe division
United
SHEET METAL COMPANY INC
COLUMBUS, OHIO STOCKTON, CAL.

883 North Cassady Ave.
Columbus 19, Ohio

RECENT TRADE LITERATURE

Continued

Air Conditioning Equipment

Bulletin GAC 150.01 describes firm's complete line of air conditioning equipment. Includes low cfm and heavy-duty fan-coil units; remote central station and multi-zone central station air conditioners; sprayed coil dehumidifiers; high-pressure central station units; heating and ventilating units; evaporative condensers; air cooled condensers; and extended-surface heating and cooling coils. Gives specifications, construction, and performance data for each unit. — *Hi-Press Air Conditioning of America, Inc., Drayer-Hanson Div., 3301 Medford St., Los Angeles 63.*

Gas-Hydronic Heating Systems

Hard cover binder contains data on gas-fired, cast iron hot water boilers. Separated into tabbed sections for easy reference. Sections include information on packaged boilers, volume hot water heating, installation, and accessories. Gives capacity ranges, dimensions, weights, applications, charts, diagrams, ratings, wiring and piping instructions, selection tables, service hints, specifications, and other information. — *Hydrotherm, Inc., Dept. AC-7, Northvale, N.J.*

Pressure Regulators

Four page Bulletin 160 describes units ranging from $\frac{1}{2}$ to 6 in. in size with initial pressures to 300 psi steam and 600 psi air. Bronze or semi-steel bodies available with hardened stainless steel unit pilot valve, main valve, and seat. Both screwed and flanged connections are available. Illustrated with cut-a-way views and component close-ups. Lists roughing-in dimensions and weights. — *O. C. Keckley Co., 3402 Cleveland St., Skokie, Ill.*

but what does it cost INSTALLED?

Anchoring to masonry, a big part of "in place" cost, includes at least three items: anchors, drills, labor. The cheapest anchor, if it isn't right for the job, may be the costliest to install.

For an economical, effective installation, help yourself to The Rawlplug Company's 40 years of experience designing, manufacturing, testing, and using anchors and drills for fastening just about every type of fixture to every type of masonry. Because we make a full line of masonry anchoring products, we can and will advise you impartially.

Our masonry anchoring know-how is summed up for you in an interesting eight-page booklet, "Install It for Less." For a free copy, ask your local Rawlplug branch or distributor, or use the handy coupon. Before you start to put that unit in place, see how you can anchor it to masonry for the lowest cost INSTALLED.

RAWL

1921-1961
ANCHORING AND DRILLING
PRODUCTS FOR FASTENING
ANYTHING TO MASONRY

R-24

The RAWLPLUG Company, Inc.
252 Petersville Road, New Rochelle, N.Y.
Please send a FREE copy of "Install It for Less" to:

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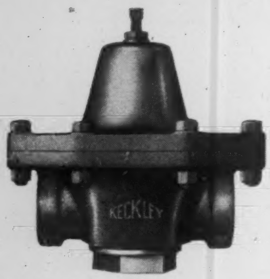
MORE VALVE FOR LESS MONEY

New! Pressure reducing valve — full ported orifice



No. 11A

Write for Bulletin No. 760

The new Keckley No. 11A and No. 11R pressure reducing and relief valves feature a full ported orifice for greater capacity and increased flow of steam, air, water, oil and gas applications.

This enables the No. 11A and No. 11R to fit many applications presently requiring larger ordinary and/or more expensive valves at substantial savings.

This single seated No. 11A and No. 11R has a semi-steel body, bronze or stainless steel trim and composition disc; and are suitable for initial pressures up to 250 lbs. steam, 450° F.; 500 lbs water, oil and gas, non-shock, 100° F. Reduced pressures range from one pound to 100 lbs. Sizes ⅜″ to 2″.

O. C. KECKLEY COMPANY

General Offices and Factory

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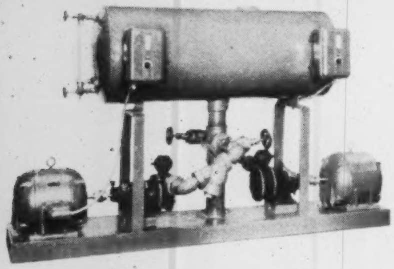
Pressure Regulators • Temperature Regulators • Float Valves
Strainers • Solenoid Valves • Reducing Valves
Pop Safety Valves • Relief Valves

EAGAN BOILER FEED UNITS

. . . give you **5 BIG BENEFITS**



EAGAN Packaged Units have a heavy steel Receiver above the pump to prevent flashing when the traps begin to leak. The Receiver has excess capacity against flooding during surges not relieved by boiler demand and the pumps have a generous reserve capacity.

Single or duplex EAGAN models are available in capacities to 100,000 sq ft. at 200 psi. Straight line arrangement of the duplex unit saves space, provides easy maintenance. Repair or inspection of one unit can be made without halting operations.

Write, wire or phone for more details on EAGAN Boiler Feed Units to suit your requirements.

1. You get economy because an EAGAN unit combines return of Hot Condensate with Boiler Water Make-up.
2. Your fuel costs are lower because fresh water is raised to about 140° requiring less heating.
3. You reduce maintenance since reusing condensate means less water treatment, less boiler scale.
4. Your boiler capacity is increased since less heat is required to make steam from hot water than cold.
5. In addition, you minimize boiler tube and plate strain because of tempered return.

Walter H. Eagan Co., Inc.

2336 FAIRMOUNT AVE.,
PHILADELPHIA 30, PA.
CEnter 6-2300

RECENT TRADE LITERATURE

Continued

Pressure Switches

Two page Bulletin E9 describes externally adjustable pressure and differential pressure switches for 15 to 200 psi differential pressure service. Switches can withstand system pressures up to 5000 psi. Gives construction and operation data of "Deltadyne" units. Actuation mechanism is illustrated with photos and drawings. Gives information on optional accessories, pressure and temperature ranges, and fluid service. — *Pall Corp., 30 Sea Cliff Ave., Glen Cove, N.Y.*

Oil Bath Air Cleaner

Eight page Bulletin 160-C describes low resistance "Model C Type P Cycoil" unit with pneumatic oil lift. Cleans intake air to engines, compressors, and blowers. Drawings illustrate component parts, construction, and dimensions. Graphs chart capacity and resistance curves. Information given on installation, maintenance, oil recommendations, filter cell service, model size selection, efficiencies, and dust holding capacities of air cleaner. — *American Air Filter Co., Inc., Dept. PD, 215 Central Ave., Louisville 8, Ky.*

Dial Thermometers

Twenty page Catalog 155 describes bi-metal dial thermometers. Every type of connection is available. One connection allows unit to be mounted in any position. Selection of features desired include removable ring, "Maxivision" dial, adjustable pointer, hermetically sealed with external adjustment. Every thermometer available shown individually with construction features, sizes, stem lengths, dimensions, weights, and general specifications. — *Manning, Maxwell & Moore, Inc., Stratford, Conn.*

RECENT TRADE LITERATURE
Continued

Power Tools and Accessories

Sixty-eight page catalog describes power tools used in construction and maintenance. Includes over 200 illustrations, information on product features and applications, and complete specifications. — *Skil Corp., 5033 Elston Ave., Chicago 30.*

Axial Flow Fans

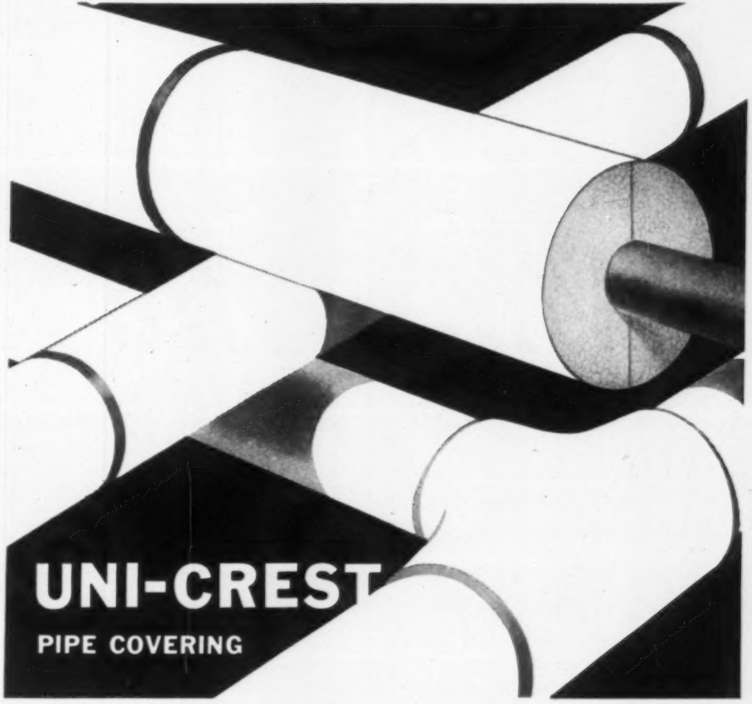
Sixteen page Bulletin AFF-61 describes fans with direct-connected motors and V-belt drives. Gives construction data, optional equipment, specifications, and tables of capacities and dimensions. — *L. J. Wing Co., 2300 N. Stiles St., Linden, N.J.*

Carbon Steel Hinged Closures

Six page Brochure TT-1034 describes units for blanking off pipeline ends and tank or vessel openings. Sizes from 2 through 42 in. for ASA 150, 300, and 600 psi service, with larger sizes and other pressure classes available. Counter-balanced, spring-loaded types for vertical applications in sizes 8 through 42 in. for ASA 150 psi service, and 8 through 30 in. for 300 and 600 psi service. Charts give dimensional specifications. Illustrated with photos and line drawings. — *Tube Turns Div., Chemetron Corp., Louisville, Ky.*

Hot Water Storage Tank Heaters

Sixteen page Catalog 602 describes complete line of tanks including steel, cement lined, copper lined, solid copper-silicon, and firm's special lining models. Also describes heating elements for these tanks. Application data, piping diagrams, engineering data, and complete heating capacity charts given. Catalog tabbed for easy reference. — *Old Dominion Iron & Steel Corp., Belle Isle, Richmond 3, Va.*



a new, economical, low temperature insulation

Uni-Crest expanded polystyrene pipe covering is an excellent low temperature insulating material, and is inexpensive to install and maintain.

Its low thermal conductivity (K factor) plus its high resistance to water and water vapor — are some of its prime qualities. It will not rot, mildew, or support fungus growth.

Extremely lightweight, with a smooth, tough white surface, Uni-Crest is non-dusting, non-flaking, and easily cut and handled on the job.

Uni-Crest and self-extinguishing Uni-Crest are available in a wide variety of sizes and shapes. Both types are also available with or without a paper and foil laminate jacket.

For the address of the office nearest you, plus additional information and an actual sample, please write to the address below.

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UNITED'S UNI-CREST EXPANDED POLYSTYRENE
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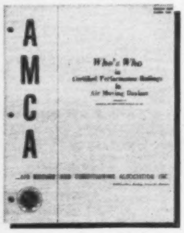
Who's Who

The first edition of "Who's Who in Certified Performance Ratings" is now available to users and specifiers of air moving equipment. This new publication of the Air Moving and Conditioning Association meets the recognized need for an official directory of manufacturers and products licensed by AMCA to use the Certified Ratings Seal.

in Certified

The 54-page directory contains essential product identification data on all air moving devices which have been tested and rated for performance in accordance with the rigid requirements of the AMCA Certified Ratings Program. Revised issues will be published periodically.



Copies of Bulletin 261A, "Who's Who in Certified Performance Ratings" are available from: Air Moving and Conditioning Association, Inc., 2159 Guardian Building, Detroit 26, Michigan.

Ratings?

RECENT TRADE LITERATURE

Continued

Air Conditioning Equipment

Six page Form LL-482 describes air cooled and water cooled air conditioning equipment. Gives specifications of all units rated from 40,000 to 420,000 Btu per hr. Application data included. — *Chrysler Corp., Airtemp Div., 1600 Webster St., Dayton 4, O.*

Canned Pumps

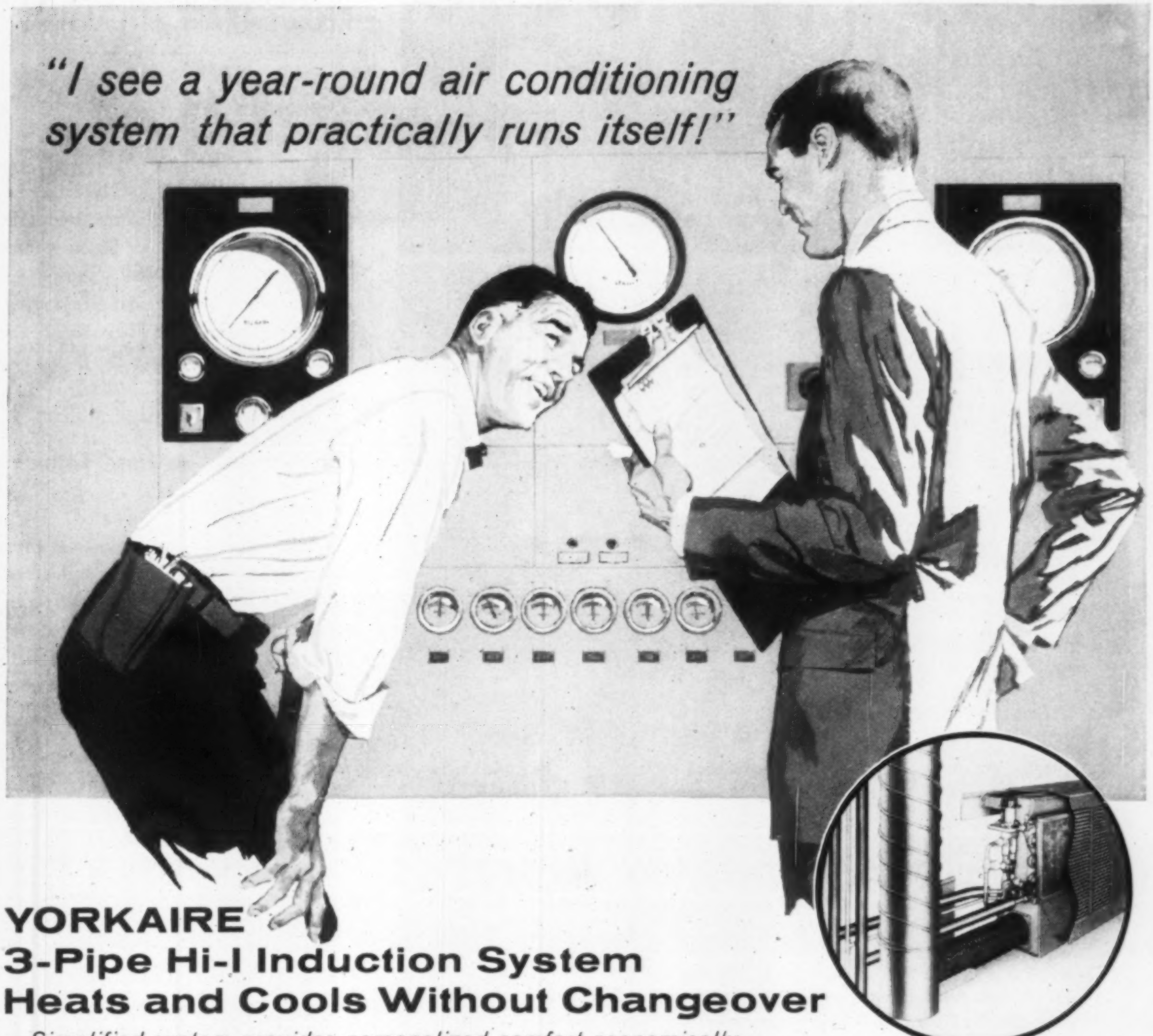
Two page Bulletin 1030-3 describes units with pumped fluid pressure limit of 150 psi and temperature limits of 180 or 400 F, depending on type of insulation. Operates on three phase, 220/400 v. Unit has only one moving part, a combined rotor and impeller assembly. Gives general specifications and a performance curve. Illustrated with a cut-a-way photo. — *Fostoria Corp., Chempump Div., Huntingdon Valley, Pa.*

Air Conditioning Controls

Eight page Bulletin GEA-7316 describes definite purpose contactors and starters for air conditioning and refrigeration. Units available in 30, 40, 50, and 60 amp models. Also describes overload relays, custom control panels, and a step starting accessory. Outline drawings and dimensions shown for both open and enclosed starters and contactors. Gives load data, coil data, outline numbers, wiring diagrams, and weights of devices. Selection guide lists nomenclature and current ratings. — *General Electric Co., Schenectady 5, N.Y.*

Bronze Gate Valve

One page Bulletin 103 describes full opening unit tested for 125 psi WWP and available in sizes 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, and 2 in. Unit has "O" ring packing. — *American Valve Manufacturing Co., 22 Bayview Ave., Manhasset, L.I., N.Y.*


"I see a year-round air conditioning system that practically runs itself!"

YORKAIRE
3-Pipe Hi-I Induction System Heats and Cools Without Changeover

—Simplified system provides personalized comfort economically

HOT AND COLD WATER AT EACH UNIT—York-designed, non-mixing, 3-way control valve selects either hot or cold water and modulates the flow to the coils to provide the desired room temperature at any time of day, all through the year.

HIGHER LEVEL OF COMFORT—Having both hot and cold source at each unit means instant response and allows wider temperature variation from room to room. This provides greatest personalized comfort and satisfies each occupant's exact wishes.

ELIMINATES MANY COSTLY COMPONENTS—Initial cost of York's 3-Pipe System is competitive with regular 2-pipe systems. Eliminating duplicate zoning equipment, costly controls and excess primary air offsets cost of third pipe, saves space.

LOWER OPERATING COSTS—Each unit functions as a separate zone receiving just the right amount of either warm or cold water to maintain desired space conditions. If neither heating or cooling is needed, there's no flow. *No wasted energy!*

Another YORK Trail Blazer Concept Proved in Action at *Statler-Hilton Hotel, Boston, Mass.*—York 3-Pipe Hi-I Induction System delivers instant personalized comfort to 1,300 guest rooms. Compact, modern induction units replaced radiators, provide heating *and* cooling in same place.

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Subsidiary of Borg-Warner Corp.
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Air Conditioning, Heating, Refrigeration and Ice-Making Equipment • Products for Home, Commercial and Industrial Applications

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ONE
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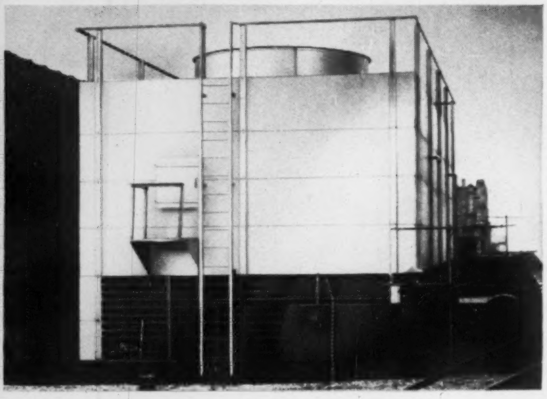


The LaSalle Hotel, Chicago...

Saves $486^{80} per day with Binks cooling towers!

"Without our Binks cooling towers our water bill would run $500 a day. As it is we pay only $13.20 per day for 86,000 gallons of makeup water . . . a savings of $486.80," reports Mr. J. E. Petermann, chief engineer of the LaSalle Hotel.

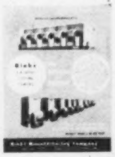
This 1000-room hotel now has two Binks 2-K cooling towers, one 2-fan unit installed in 1960 and a separate 1-fan tower which has been operating since 1955.

The new 2-K tower replaced a smaller Binks unit which had been in use for 23 years and was still operating perfectly when dismantled to make room for the new tower.

Two factors influenced the choice of another Binks tower . . . outstanding performance of the first two units and lower first cost of the new tower. Because Binks equipment is of modular design it is highly flexible. Expensive custom work or modifications were not necessary.

Free Specification Data

In 9 cases out of 10 a standard Binks cooling tower will meet your requirements exactly at a substantial saving. Write for mechanical and performance specifications.



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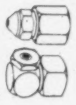
Binks
EVERYTHING FOR WATER COOLING



A COMPLETE LINE OF NATURAL DRAFT AND MECHANICAL DRAFT COOLING TOWERS AND INDUSTRIAL SPRAY NOZZLES

Binks Manufacturing Company
3144-A Carroll Ave., Chicago 12, Ill.

REPRESENTATIVES IN PRINCIPAL U.S. & CANADIAN CITIES • SEE YOUR CLASSIFIED ☎ DIRECTORY

RECENT TRADE LITERATURE

Continued

Solenoid Valves

Four page Bulletin SL-1 gives selection data for solenoid valves. Information on size, pressure, temperature, coil type, special features and assemblies is included. Shows Cv flow factors used for sizing of valves. — *J. D. Gould Co.,* 4707 *Massachusetts Ave., Indianapolis* 18, *Ind.*

Pressure Clamps, Hose Fittings

Twenty-four page catalog, Form B-5, describes line of industrial pressure clamps, hose fittings, and accessories. Includes illustrations, specifications, shipping weights, and clamp test results. Lists products with British Standard Pipe Threads as well as American National Taper Pipe Threads. — *Band-It Co.,* 4779 *Dahlia St., Denver* 16, *Colo.*

Underground Piping Insulation

Bulletin describes insulation made of a combination of high softening point petroleum-asphalt blended with inorganic glass-like beads of volcanic rock. Also describes pipe primer used with insulation. — *Insul-Fil Co., Inc.,* 250 *Pettit Ave., Bellmore, L.I., N.Y.*

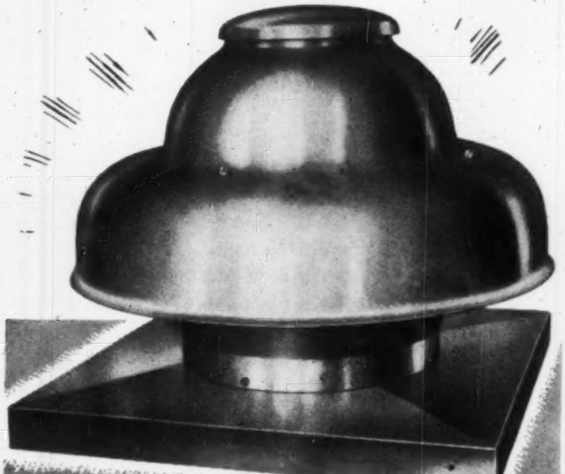
Strip Heaters

Twelve page Catalog C-300 describes electric units for heating ovens, process welding, outdoor control equipment, forced warm air heating, radiant heating, and baseboard heating. Gives high and low temperature ratings, wattages, voltages, and dimensions. Series of tables give average specific heats and other physical characteristics of various common solids, liquids, gases, and vapors. Illustrated with photos, drawings, diagrams, and graphs. — *The Bryant Electric Co., P.O. Box D, Barnum Station, Bridgeport* 2, *Conn.*

Aladdin

AIR HANDLING EQUIPMENT

Type "S" *Centrifugal* ROOF VENTILATORS



- CERTIFIED RATINGS
- ALUMINUM HOUSED
- ATTRACTIVE DESIGN
- WEATHERPROOF
- QUIET OPERATION

CERTIFIED RATINGS
AUTHORIZED BY
AMCA

ALADDIN Type "S" Roof Ventilators feature an attractive Spun Aluminum Housing of low contour. Designed especially for those installations which require a small powered exhaust unit. The Type "S" Roof Ventilator is ideally suited for schools, hospitals and similar type buildings.

Seldom requiring maintenance, these units are furnished with unusually quiet, fan cooled motors with outstanding lubricating systems, assuring long, continuous service under severe conditions of dust and dirt.

Write for complete data

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

Swiss Chancery Building, Washington, D.C.

LO-BLAST

POWER GAS BURNERS SELECTED FOR SWISS CHANCERY

A pair of No. 5N-4 Lo-BLAST Burners supply 2,000,000 BTU/hr. each

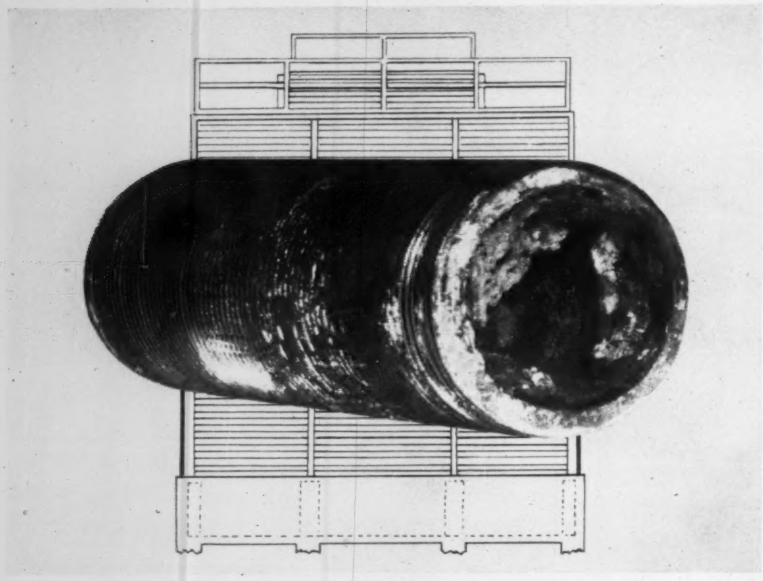
Lo-BLAST Power Gas Burners were selected for this installation *because they eliminate the fuel waste caused by uncontrolled draft!*

The Lo-BLAST Burner uses an extremely quiet, low speed blower to provide perfectly controlled primary and secondary air. Operation is always independent of natural draft conditions—when the burner shuts off, the flow of air stops, permitting the heating plant to retain much of its heat. Combustion is completed in an incandescent firebox, with radiant heat applied to the crown sheet as well as side walls.

Lo-BLAST eliminates the need for high chimneys—"inshot" design cuts maintenance—complete factory assembly reduces installation costs. Each unit is factory tested on gas before shipment.

Lo-BLAST and Economite Power Gas Burners are available in capacities from 75,000 to 20,000,000 BTU/hr. Write for literature.

MID-CONTINENT
METAL PRODUCTS CO.
1960 N. CLYBOURN AVE., CHICAGO 14, ILLINOIS



COOLING WATER CORROSION MUST BE STOPPED!

Unchecked scale deposit and corrosion in your air conditioning system can cut its life by years . . . increase maintenance and replacement problems several-fold.

Bird-Archer Series 5900 chromate formulations stop severe scaling and corrosion easily, effectively and economically, adjust pH to safe, neutral ranges. In small systems, treatments are added to the circulating water directly from the shipping container through a specially designed Micro-Feeder, eliminating the necessity for manual, daily chemical feeding. For larger units special chemical feed equipment is available.

Write for Bulletin 117 and the name of the Bird-Archer Service Engineer nearest you.

BA-100

BIRD-ARCHER
WATER TREATING CONSULTANTS
The BIRD-ARCHER Company, 4337 N. American St., Phila. 40, Pa. / New York • Chicago
The BIRD-ARCHER CO. of California, 415 Brannan St., San Francisco • Offices in Canada and Mexico

RECENT TRADE LITERATURE

Continued

Process Thermostats

Two page Bulletin 3560 describes unit sealed for protection against moisture, corrosion, fumes, and dust. Gives ratings, ranges, tolerances, and differentials. Illustrated with photos and line drawings. — *Stevens Manufacturing Co., Inc., P.O. Box 1007, Mansfield, O.*

Right-Angle Worm Gear Motors

Six page Brochure F-1971 describes units in single reduction type "GW" and the double reduction type "GWB." Speeds of 3.25 to 230 rpm (positive speed reduction provides standard AGMA output speeds) and gear ratios up to 87:1 shown for type "GW," and ratios up to 354:1 for type "GBW." Units rated at 1/3, ½, ¾, 1, 1½, and 2 hp. Brochure gives ratings and dimensional data and shows a number of specialized models, including totally enclosed, explosion proof, flange mounted, single phase, and variable speed. Optional mounting and assembly positions also illustrated. — *U.S. Electrical Motors Inc., P.O. Box 2058 Terminal Annex, Los Angeles 54.*

Metallic Sealing Compound

One page bulletin describes copper, bronze, and lead sealing compound for sealing leaks in hot water tanks and heating plants, and for sealing pipe connections. — *Reardon Products, 305 Cass St., Peoria, Ill.*

Clamp Assemblies

Twelve page Catalog JF-61 describes clamp assemblies and fixture components. Over 1000 items featured. Illustrated with line drawings and charts. — *Accurate Bushing Co., 440 North Ave., Garwood, N.J.*

AGITAIR® Decoraire

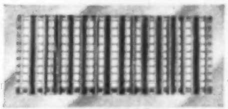
EXTRUDED ALUMINUM
REGISTERS . . . GRILLES

FOR SHEER ARCHITECTURAL BEAUTY AND EFFICIENCY

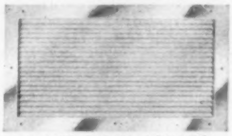
Whether you use one foot of DECORAIRE or a thousand foot run or more, you can be sure that these extruded aluminum grilles or registers will give maximum performance to assure complete users satisfaction.

DECORAIRE incorporates desirable practical features . . . APPEARANCE . . . PERFORMANCE . . . VERSATILITY to meet the exacting requirements of architects, engineers and contractors.

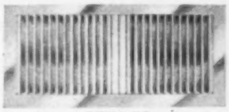
ALSO A COMPLETE LINE OF REGISTERS – GRILLES



REGISTERS



SIGHT TIGHT GRILLES



GRILLES

To meet every requirement of the architect and designer, there is also available AGITAIR Registers and Grilles in a wide range of sizes and styles.

Ask for catalog R-G-100.

AIR DEVICES INC., 185 MADISON AVE., NEW YORK 16, N. Y.
BETTER PRODUCTS FOR AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

You can depend on Wiedeke quality

Guard holds Flare Roll Back—desirable for rolling Tubes closely spaced in thin Tube Sheets.

Package Boiler

. . . and Stationary Fire Tube Boiler Tubes can be rolled and flared in one operation with this Modern Parallel Rolling Tube Expander.

See your Dealer or Write us for Bulletin 3400.

THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

FINGER-TIP COMMUNICATION

the DUO-COM 100 WALKIE-TALKIE

Osborne's DUO-COM 100 pocket size *walkie-talkie* . . . a completely self contained transmitter and receiver that weighs only 20 ounces. No license or permits required . . . may be operated by anyone regardless of age or citizenship with dependable communication ranges up to 5 miles. Operates for pennies and is priced at only **$99.50** each or the DUO-COM 100S with an efficient squelch control at **$119.50** each.

The perfect companion . . . the OSBORNE 300 "Class D" base station at **$149.50**

OSBORNE ELECTRONICS CORP. Dept. A6
13105 S. Crenshaw Blvd. • Hawthorne, Calif.

Please rush me complete details on your ☐ DUO-COM 100 ☐ DUO-COM 100S ☐ OSBORNE 300

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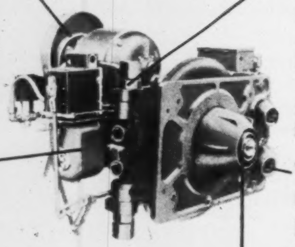
CITY __________ ZONE ____ STATE __________



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—are YOURS for

BIGGER BURNER SALES

—AND HIGH CUSTOMER SATISFACTION!

V-BELT DRIVE — EXCLUSIVELY

ENTERPRISE pioneered V-Belt drive for Horizontal Rotary Oil Burners. For 15 years they have been used *exclusively,* for greater efficiency, flexibility and economy!

"MEASURED-RATE" METERING PUMP

Provides for *exact* delivery of the *proper* quantity of oil to the burner — regardless of changes in temperature and viscosity. Another ENTERPRISE first!

LEAK-PROOF HINGE DESIGN

New burner hinge does away with troublesome, leaky packing glands. "O" rings provide for positive, long-life sealing at this critical point!

VENTURI-TYPE IGNITER

Preferred for automatic starting, the ENTERPRISE igniter produces a clean, torch-like flame that eliminates carbonizing, provides failure-proof ignition.

"ANGLE-VANE" AIR NOZZLE

Provides full flame pattern control and efficiency regardless of firebox size and shape!

QUALITY PLUS ENTERPRISE SERVICE —THE RIGHT COMBINATION FOR CONTINUED SUCCESS

ENTERPRISE delivers the "plus" factors that ring up sales, profits and satisfied customers — the key to continued success for ENTERPRISE distributors and dealers. Now is the time to find out about ENTERPRISE — the profit line in commercial and industrial burners. Write today for information.

ENTERPRISE ENGINE & MACHINERY CO.

The Choice of Heating Experts

ENTERPRISE

DEPENDABLE BURNERS

Adel Division, General Metals Corporation • 1444 Washington Ave., Huntington 1, W. Va.

RECENT TRADE LITERATURE

Continued

Torque Measuring Instruments

Twelve page bulletin, "Torque and Efficiency Measurements," illustrates how to measure torque characteristics and speed of motors, gear trains, servo mechanisms, and potentiometers. Covers torque ranges from 1/4 gm-cm to 200 lb-in. Includes formulas for computing power and efficiency and methods of using stroboscopes and tachometers for analyzing rotating motion. — *Power Instruments, Inc., 7352 N. Lawndale Ave., Skokie, Ill.*

Temperature Probes

Forty-four page Catalog 61 describes temperature probes and accessories, and explains instrumentation theory. Units used to measure temperature, velocity, and flow direction of flowing fluids, gases, and liquids at any desired point. Illustrated with charts, drawings, and tables. — *United Sensor & Control Co., P.O. Box 127, Glastonbury, Conn.*

Electrical Testing Instrument

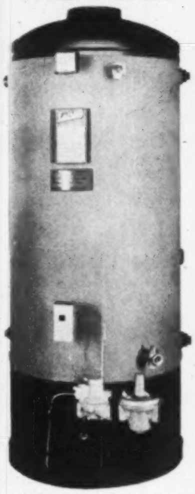
Four page Catalog A658 describes snap-around unit for measuring amperage, voltage, and ohms. Pocket size "Amprobe" has five current ranges, three voltage ranges, and one ohmmeter range. Accuracy is within ±3 percent of full scale. Gives ratings, dimensions, and lists accessory equipment. Illustrated with photos and line drawings. — *Pyramid Instrument Corp., Lynbrook, L.I., N.Y.*

Thermometers and Hydrometers

Twenty-four page Catalog 19-C lists units for measuring temperature and specific gravity. Ranges listed in tabular form. Illustrated with photos and drawings. — *H-B Instrument Co., American and Bristol Sts., Philadelphia 40.*

Announcing

4 NEW MODELS



USES ANY TYPE GAS

Ewing

FULLY AUTOMATIC GAS-OPERATED

COMPACT VERTICAL TYPE COMMERCIAL-INDUSTRIAL

WATER HEATERS & BOILERS

A Ewing Heater-Boiler ELIMINATES EXPENSIVE, SPACE-CONSUMING STORAGE TANKS. THE VERTICAL DESIGN ALSO SAVES VALUABLE FLOOR SPACE. Choice of 4 sizes for a multitude of uses.

Perfect for: **APARTMENT BUILDINGS, ATHLETIC PLANTS, BAKERIES, CHURCHES, BATH HOUSES, BARBER AND BEAUTY SHOPS, CLINICS, COUNTRY CLUBS, BAPTISTRIES, QUICK CAR LAUNDRIES, HOSPITALS, HOTELS, MOTELS, FOOD ESTABLISHMENTS, OFFICE BUILDINGS, SUPER MARKETS, LAUNDRIES OF ALL TYPES, CLEANING PLANTS, SERVICE STATIONS, INDUSTRIAL PLANTS AND MACHINE SHOPS, POULTRY PROCESSING PLANTS, ENGRAVING AND PLATING PLANTS, SWIMMING POOLS AND MANY OTHER USES.**

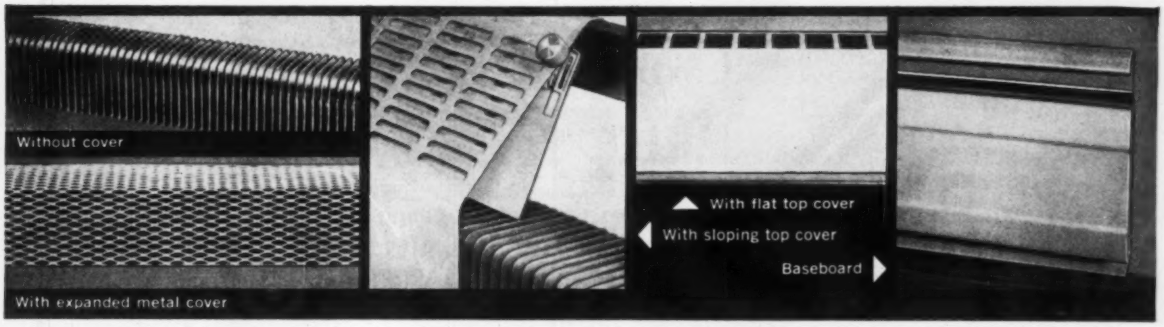
All four models are built to specifications, meeting American Gas Association requirements, and are approved by its testing laboratories. Also tested and inspected in accordance with the rules of ASME Heater and Pressure Vessel Code. Each unit superbly engineered.

Burner assembly complete and factory installed—Gas Pressure Regulator—AGA and ASME Temperature & Pressure Relief Valve—Temperature & Pressure Gauge—Gas Valve—Aquastat—Draft Diverter—Dielectric Unions—Magnesium Rods—All Controls Self-generating.

Thousands in operation from Coast to Coast. Backed by quality construction and experience dating back to 1924. The Ewing name is your guarantee of satisfactory and economical operation. Ewing models are quick and easy to install. Ask a Ewing owner what HE thinks of his Ewing heater-boiler.

SEND FOR SPECIFICATIONS, PRICES
Complete data sheet, specifications and prices upon request. Recovery capacities 268 to 1984 gallons per hour at 100 degrees temp. rise.

Ewing MANUFACTURING CO.
2545 NW 10 P. O. BOX 875
OKLAHOMA CITY, OKLA.



32 different copper and steel heater elements to choose from in the complete SARCOfIN line.

Choose the finned tube radiation that best meets your requirements—from the complete Sarcofin line. Choice of 32 different heating elements. Eight types of enclosures: flat-top, expanded metal, sloping top, modified flat top, sill-type and three baseboard cover types.

And for old or new homes, remember the variety, flexibility, and easy installation of Sarco-Pak baseboard radiation.

All ratings are approved under the I-B-R code. For your extra convenience, standard length "packages" are now available. Superb appearance matches high Sarco quality.

You always get the advantage of single-source responsibility, when you specify Sarco-Sarcotherm for all your finned-tube radiation, heating specialties, pumps, regulators, and weather-compensated control systems. Write for your copies of latest bulletins on Finned-Tube Commercial Radiation and Baseboard Radiation.

2363

SARCO

SARCO COMPANY, INC
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT BETHLEHEM, PA

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

RECENT TRADE LITERATURE

Continued

Curtain Walls

Twenty-four page 1961 catalog describes single system that integrates exterior walls, air handling units, and (when desired) under-sill storage cabinets. Gives fundamental principles of application. Data on window types and arrangements, panel materials, and construction is included. Air handling units electrically operated. Cooling capacities range from 7000 to 16,000 Btu per hr. Operating as heat pumps, units will supply heating where design conditions are not extreme. System has individual control. Catalog illustrated with photos and diagrams. — *Michael Flynn Manufacturing Co., 700 E. Godfrey Ave., Philadelphia* 24.

Multi-Point Controller

Eight page bulletin, 52, describes "Thermo Electronic" multi-point controller for automatic two position control of up to 10 industrial processes; three position control of five processes; constant control of a single process; manual balance indication of exact process conditions at each point controlled; and monitoring facilities for controlled points; or others. Information given on various applications of the bridge or potentiometer circuits. Includes specifications and photos of unit. — *Thermo Electric Co., Inc., Saddle Brook, N.J.*

High Frequency Electric Tools

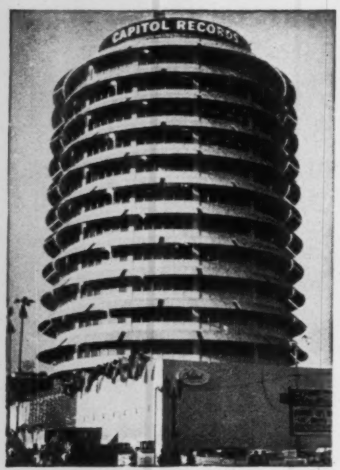
Thirty-two page Bulletin 62 describes tools such as impact wrenches, drills, and other products. Presents an analysis of high frequency tools with a capsulized report on the advantages of using 180, 360, or 400 cycle tools for specific job applications. — *Thor Power Tool Co.,* 175 *N. State St., Aurora, Ill.*

Silver Brazing Alloys

Twenty-four page Form ADC 847C discusses brazing procedures, problems, and solutions for silver brazing alloys. Lists selection data, advantages, and various processes involved in brazing operations. Illustrated with photos, drawings, tables, and charts. — *Air Reduction Co., Inc., Air Reduction Sales Co.,* 150 *E. 42nd St., New York* 17.

Preventing Water Troubles

Report discusses the problems involved with cooling and circulating water. Such topics as: how solids, dissolved gases, algae, and bacteria cause trouble; and trouble in hot water and chilled water systems, diesel and gas engines, compressors, cooling towers, and evaporator condensers are discussed. — *Associated Laboratories, Inc.,* 26845 *Southfield Rd., Lathrup Village, Mich.*



CAPITOL RECORDS BLDG.
LOS ANGELES, CAL.

WELTON, BECKET & ASSOCIATES, ARCHITECTS-ENGINEERS, STATE PLUMBING & HEATING CO., MECHANICAL CONTRACTOR

Capitalize on

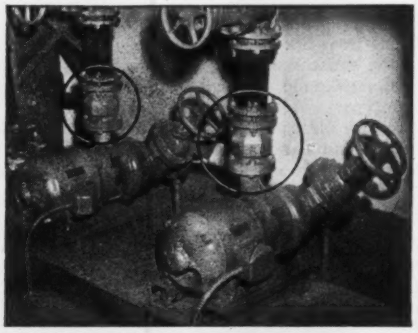
MILLER Streamflow CHECK VALVES

Completely Silences your piping system! CENTER-GUIDED, SHOCK PROOF, NOISELESS, ELIMINATES WATER HAMMER. FULL RADIAL FLOW. FACTORY MUTUAL LABORATORIES APPROVED.

SIZES 1" THROUGH 24"

FLANGED, ASA DRILLING, IBBM, CAST STEEL, ALL ALLOYS FOR ALL FLUIDS AND GASES.

CERTIFIED MINIMUM PRESSURE DROP CURVE AVAILABLE



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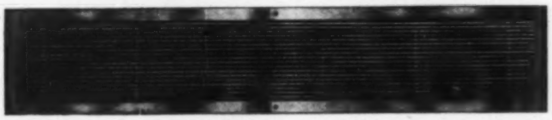
MILLER VALVE CO., INC.

Pittsburgh 30, Pa. Plant—1620 Pennsylvania Ave.

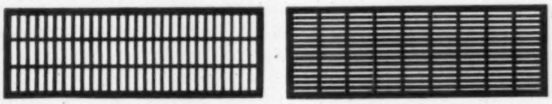
In America's Finest Buildings...
DIAMOND GRILLES

LOOK BETTER... LAST LONGER!

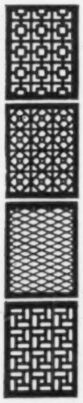


DIAMOND FABRICATED GRILLES

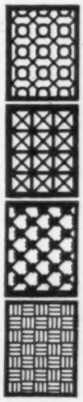
. . meet the current demand for a very strong bar-type grille which provides more than the usual percentage of open area and is suitable, in general appearance, for use with practically any modern style of interior design. Specified by leading engineers and architects for Schools, Colleges, Hospitals, Ocean Liners, Sports Arenas, etc. Custom Built (no standard sizes) in any specified rectangular size or shape — All Steel or All Aluminum — for either direct or deflected air flow. Write for Bulletin 43.



DIAMOND ARCHITECTURAL GRILLES



. . . are stamped from Steel, Aluminum, Bronze or any other commercial metal; in a wide variety of artistic designs, in any desired thickness up to one-quarter inch, with correspondingly LARGE unit openings. Widely used, for nearly half a century, in America's finest buildings, they have proved practically indestructible — standing up for years against any probable amount of rough usage. Bulletin 41 illustrates and describes a number of popular designs and applications. Catalog 36 (100 pages) contains actual-size illustrations of ALL Diamond Grille designs, together with complete working data. Write for either or both — no charge or obligation.



DIAMOND MANUFACTURING CO.
Box 41 WYOMING PENNA.
(Wilkes-Barre Area)

Specify Cook

ALL ALUMINUM VENTILATORS

THE ONLY VENTILATOR WITH A 5 YEAR WARRANTY

FOR LOWER OVERALL COSTS

Service calls quickly eat-up any price advantage of so-called bargain ventilators. Save time, trouble and money! Cook Ventilators are engineered to perform as specified without pampering.

Other cost cutting advantages reduce overall costs even more:

LESS ROOF LOAD

All Aluminum construction reduces weight—requires less supporting roof structure.

LESS INSTALLATION TIME

Designed for quick, easy installation. Pipe conduit simplifies wiring. Prefabricated curb is available to cut installation costs even further.

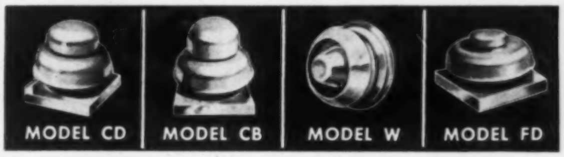
LESS MAINTENANCE

Aluminum construction eliminates need for paint. Removal of four cap nuts permits shell to be removed for inspection of moving parts. Sealed bearings and motors reduce lubrication need.

These features reduce costs at both the construction and operating level.

Install Cook Ventilators and forget them!

For complete specifications and description of the Cook line, See Sweet's Architectural or mail the coupon.



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Company____________________

Address____________________

City__________ Zone_____ State__________

Cook ALL ALUMINUM VENTILATORS
THE LOREN COOK COMPANY
BEREA, OHIO
MEMBER AMCA

WE HEAR THAT . . .

DEUTSCHE CONTROLS G mb H is the name of the new German sales and service headquarters for *CONTROLS CO. OF AMERICA.*

The *NATIONAL SUPPLY DIV. OF ARMCO STEEL CORP.* has moved its Chicago office to the Kemper Building, 20 N. Wacker Dr.

AEOR-TEST EQUIPMENT CO., INC. has acquired the assets of the Gascool Div. of *VECTOR ENGINERING CONTRACTORS, INC.*

A group of employees of the *BAYLEY BLOWER CO.* has purchased all of the firm's common stock from the *GREEN FUEL ECONOMIZER CO.*

CRANE CO. has formed a new valve servicing and repair division with plants and offices throughout the country to expedite the overhauling and reconditioning of industrial valves and specialty piping machinery.

BURNS & McDONNELL ENGINEEERING CO. has admitted five of its former staff members to partnership in the firm. The new partners are: Leo L. Cunningham; Jasper W. Meals; Alwin H. Rector; William W. Ruimans; and Edwin J. Ruyan.

WILLIAM O. HUEBNER will set up a consulting office and will offer his services as consultant, writer, and editor in the air distribution field. He was formerly with *ANEMOSTAT CORP.* as editor of the company publication, Aspiration. He holds a degree in mechanical engineering from Technical University, Berlin, Germany.

OWENS-CORNING FIBERGLAS CORP. has developed an estimating system for determining the proper thickness of insulation to use in a given application. Called "Dividend Engineering," the system uses thermo-economic data amassed from over 20 years of performance figures.

COPELAND REFRIGERATION CORP. has appointed Joseph D. Loveley coordinator of manufacturing and engineering.

MORE AIR MOVED MORE QUIETLY

AT LOWER TIP SPEEDS USING LESS HORSEPOWER

A new centrifugal wheel design—*"the overlapped orifice"* eliminates inlet losses and increases efficiency—wheel doesn't merely butt to the orifice ring **but** overlaps the orifice inlet.

It adds up to more air moved ultra quietly, at lower speeds and less horsepower, and substantial savings on both initial and long term costs because of the smaller sizes required.

And check these other features . . .

Spun aluminum housing, all aluminum, non-sparking, non-overloading wheel, ball bearing throughout, available in both direct and belt drive models, non-restrictive discharge design, full floating drive with rubber vibration dampeners, external wiring conduit—units designed for long, trouble free, service life.

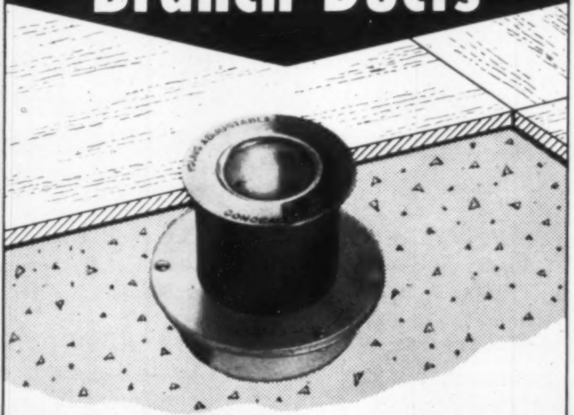
Power Line FAN COMPANY

Division of Chelsea Products, Inc., Plainfield, New Jersey

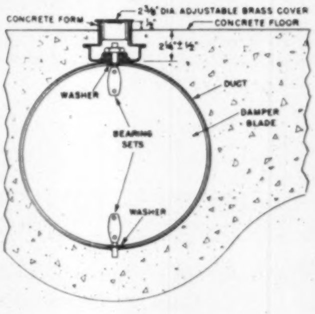
There's a Power Line Fan for every VENTILATING PROBLEM!

For a better balanced Perimeter Heating and Cooling System - *install*

YOUNG Floor Line Adjustable Cover Regulators in Branch Ducts



Adjustable Brass Cover screws down flush with floor after form is removed.


CONCRETE FORM
2 3/8" DIA ADJUSTABLE BRASS COVER
CONCRETE FLOOR
2¼" ± ½"
DUCT
WASHER
DAMPER BLADE
BEARING SETS
WASHER

The Young No. 330 Regulator, installed in a branch duct, gives *accurate* control of the volume of air to the register.

This is the *sure way* of controlling the required volume of air for individual rooms.

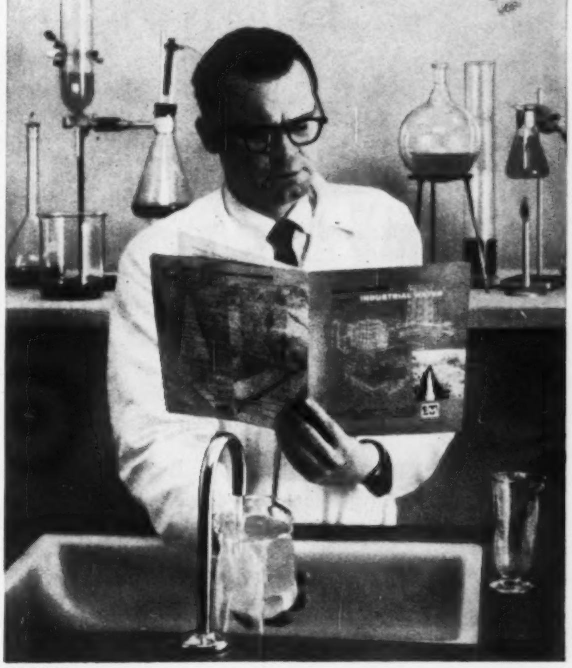
Only 2-3/8" in diameter, the adjustable cover plate fits flush with the floor. Model No. 330 is for installations with up to 2" of concrete above the duct. Other models are available for up to 12" of concrete above the duct.

Write for complete catalog or consult Sweet's Architectural File or the Engineer's Product File.

YOUNG REGULATOR COMPANY
20910 Miles Parkway, Cleveland 28, Ohio

FREE BOOKLET TELLS WHY TRANSITE® PIPE DELIVERS INDUSTRIAL WATER AT LOW COST

Send for your copy today!


INDUSTRIAL WATER

JOHNS-MANVILLE
Box 14, HP-5, New York 16, N. Y.
In Canada: Port Credit, Ontario

Please send me, without obligation, your new booklet on Transite Industrial Water Pipe.

NAME________________________________
ADDRESS________________________________
CITY________________________ZONE________
COUNTY________________STATE____________

ELECTRIC
HOT WATER HEAT
TO 2,500,000 B.T.U.
OUTPUT

SEE OUR CATALOG IN SWEET'S
OR WRITE FOR COPY

PRECISION
ELECTRIC HOT WATER HEATING BOILER

COMPLETE UNIT READY FOR INSTALLATION
with circulation hot water system and water chiller for year-round air conditioning.

CONVERSION EASILY ACCOMPLISHED
where other type fuels now used. Suited for home, churches, motels, apartments, hotels, hospitals, commercial buildings, swimming pools, snow melting and domestic hot water for large users. Temperature range — 60 to 250 degrees. Equipped with Sequence and Proportional Controls when desired.

- **Every unit tested and inspected 40,948 to 2,500,000 B.T.U. Output.**
- **All Boilers meet the requirements of the ASME Boiler and Pressure Vessel Code. Natl. Board approved.**

No chimney! No odors! No flame! No ducts! No noise!

Write for complete specifications and prices

PRECISION parts corporation
400-HPA NORTH FIRST STREET
NASHVILLE 7, TENNESSEE

WE HEAR THAT

Continued

HIMELBLAU ASSOCIATES, INC. have moved into a larger warehouse and offices for expediting shipments of air filters. Their new office is at 18 S. Throop St., Chicago.

BALTIMORE AIRCOIL CO., INC. has begun construction on a 40,000 sq ft addition to its plant in Baltimore. Another addition of 20,000 sq ft will be completed this summer.

SECO ELECTRONICS, INC. has been purchased by *DI-ACRO CORP.* and will be operated as a wholly-owned subsidiary.

BENJAMIN FOSTER CO. will build an 11,000 sq ft plant in Houston. The plant is scheduled for completion by June 1, 1961.

MODINE MANUFACTURING CO. will build a 30,000 sq ft production plant in McHenry, Ill. Some 170,000 sq ft of area has been graded to allow for future expansion.

FLEXONICS CORP. has been dissolved with all of its assets going to its sole shareholder, *CALUMET & HECLA, INC.* The firm's operations will be carried on under the name of *FLEXONICS*, and will be a division of Calumet & Hecla.

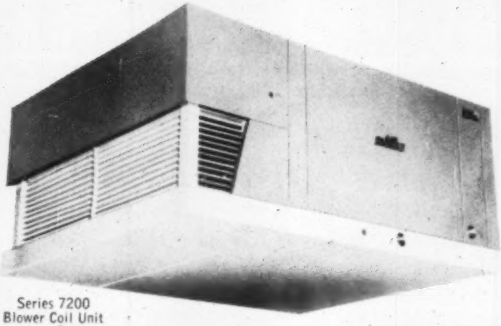
A new 120,000 sq ft addition to *THE TRANE CO.* plant in Clarksville, Tenn., has been completed at a cost of $909,000. The addition nearly doubles the size of the original plant.

The *RUBEROID CO.* has entered into the glass fiber industrial insulation market through an agreement with *PITTSBURGH PLATE GLASS CO.* Ruberoid will market several types of fiber glass insulation produced by Pittsburgh, including pipe covering, duct insulation, and duct liner.

WHITE-RODGERS CO. has purchased the assets of the *SIGNET CONTROLS DIV., IRON FIREMAN MANUFACTURING CO.* Signet's operations will be moved and integrated into White-Rodgers new plant in St. Louis.

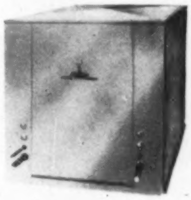
USAIRco

Air Cooled Split Systems offer Greater Flexibility



Series 7200
Blower Coil Unit
Low Side

BLOWER-COIL ASSEMBLY UNITS, Series 7200, suited for horizontal air flow. May be installed in the space to be air conditioned or remote with duct work. Also available are vertical models for floorstanding application.



Series 8300
AIR COOLED
Condensing Units
High Side

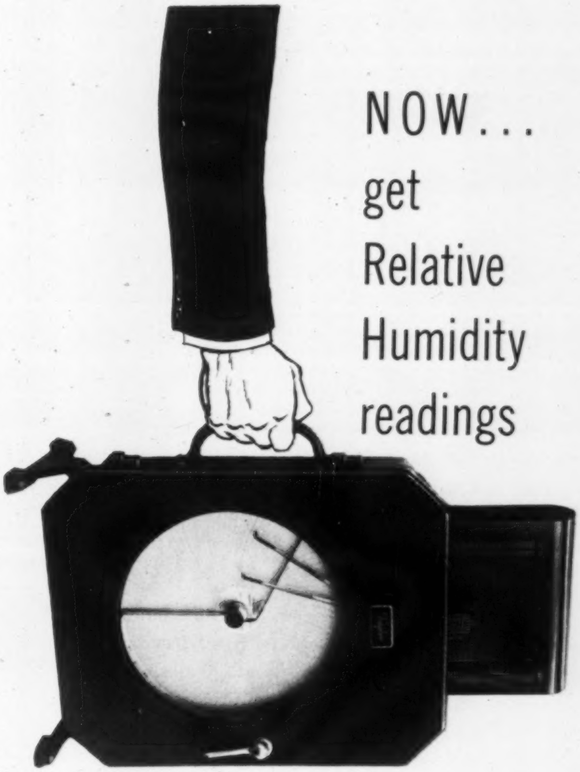
AIR-COOLED CONDENSING UNITS, Series 8300, designed for outside location, are horizontally proportioned to produce a low-silhouette for ideal on-the-roof installation.

When the Series 8300 is used with its companion Series 7200, system capacities range from 31,000 BTU/hr to 208,000 BTU/hr (based on a condenser ambient of 95 degrees).

USAIRCO Split Systems, available in 6 sizes, open a tremendous new profit opportunity in shopping center, factory, bowling lane, variety, chain, restaurant, amusement and many other commercial and industrial applications. Get the facts today.

Write for Bulletins 72B and 83B

United States Air Conditioning Corporation
DELAWARE, OHIO



NOW...
get
Relative
Humidity
readings

... directly with this portable *Taylor* recorder

The new Taylor 100J Relative Humidity Recorder offers you five distinct advantages.

It's easy to read. Pen records humidity *directly* on a 24-hour chart. No conversions to make.

It's portable. Weighs only twenty-five pounds. No water supply connections.

It's accurate. Periodic saturation doesn't affect it. No troublesome wicks to change.

It's dependable. Same mechanism as time proven 76J Recorder.

It's low cost. Off-the-shelf delivery.

Write now for **Bulletin No. 98410**

Taylor Instrument Companies
Rochester, New York, and Toronto, Ontario.

Taylor Instruments
MEAN ACCURACY FIRST

D. A. Brown has been elected executive director of the *AUTOMOTIVE AIR CONDITIONING ASSOCIATION*. He will serve for the 1961 calendar year.

THE RITTLING CORP. is moving its general offices from its Kentucky St. location in Buffalo, N.Y. to expanded facilities adjacent to its plant in Hamburg, N.Y.

Construction has begun on a new plant, office, and warehouse for the *MOR-FLO HEATER CO.* The new facility will cover 80,000 sq ft on a 12 acre site. This $575,000 plant will be completed by September, 1961.

SLOCUM & FULLER, New York mechanical and electrical consulting engineering firm, has opened a branch office in Sydney, New South Wales, Australia. The new office is being opened in association with *RANKINE AND HILL*, Australian civil and structural engineering firm.

HYNES ELECTRIC HEATING CO. has moved to new and larger quarters located at 708 Colfax Ave., Kenilworth, N.J.

The *AUSTIN CO.*, engineering and construction firm, has opened two new firms in Australia and Argentina. *AUSTIN-ANDERSON PTY. LTD.* is headquartered in Sydney, New South Wales, Australia. *AUSTIN-GRAZIANI S. A.* is headquartered in Buenos Aires, Argentina.

CRANE CO. has purchased the assets of *MIDWEST PIPING CO., INC.* The acquired firm will operate as a division of Crane.

New laboratories for research, development, and data verification will soon be completed by *COBELL INDUSTRIES, INC.*

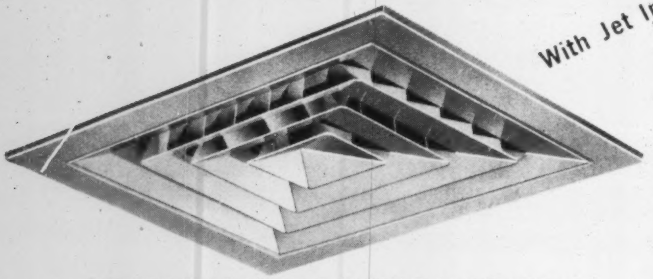
NORMAN PRODUCTS CO. will increase their plant capacity by 35,000 sq ft with the completion of a new addition. The facility is scheduled to be completed in early June.

THE ORIGINAL SQUARE AND RECTANGULAR AIR DIFFUSERS

AGITAIR®

GENUINE PRODUCTS

With Jet Induction Diffusing Vanes



STURDILY CONSTRUCTED

- All louvers are firmly welded to diffusing vanes in parallel lines.
- The louvers cannot be tampered with or altered.
- Solid construction eliminates strumming or vibration.
- A metal plate is welded at the corner joints to add greater rigidity to the unit.

MORE THAN 1,000,000 IN USE TO-DAY

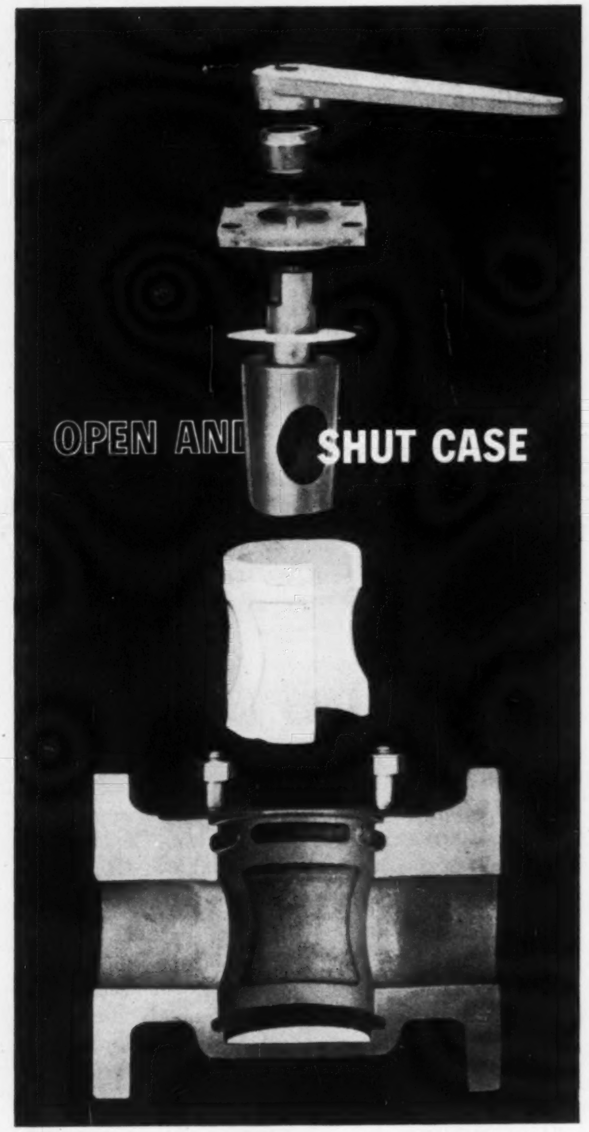
Only AGITAIR square and rectangular diffusers employ the jet induction feature due to scientically designed diffusing vanes.

These AGITAIR diffusers with built-in diffusing vanes, are designed and positioned to serve as air pumps, compressing the air into a multiplicity of jets. These jets issuing from spaces between adjacent louvers, produce a high degree of turbulence which rapidly mixes the primary and room air and assures control of the entire cubicle contents of the spaces served.

AGITAIR jet induction type diffusers are custom-made with louver arrangements for 1-2-3 or 4 way proportional blows.

Ask for technical catalog R-108

AIR DEVICES INC.
185 MADISON AVENUE, NEW YORK 16, N.Y.
BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

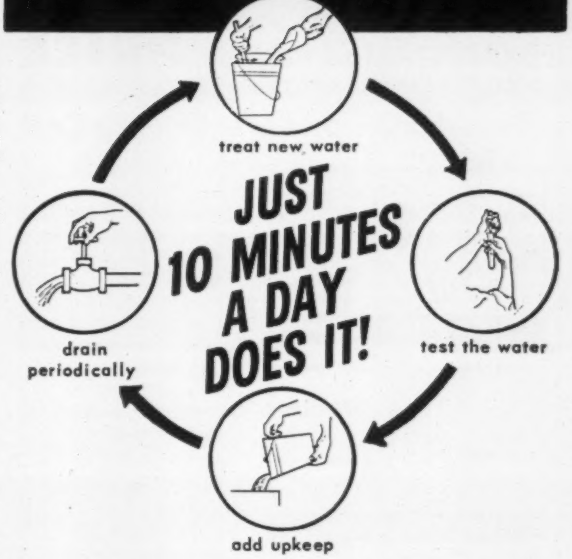


Leakproof sealing without maintenance in ON-OFF service makes an open and shut case for specifying Continental's TUFLINE non-lubricated plug valves. ■ For the facts of the case, examine closely the special high pressure sealing ribs and carefully sculptured body bore configuration. This, combined with the specially tempered pure Teflon* sleeve and tapered plug, is where Tufline valves pay off ... in bubble-tight sealing without plug adjustment even under fluctuating temperature conditions. ■ For complete information on Tufline valves ¼" through 10", 150# and 300# class, 2-way through 5-way, or jacketed, furnished in a wide range of metals for services from light hard-to-hold gases to heavy corrosive slurries, temperatures –150° F. to + 400° F., high vacuum to 615 psi (depending on temperature), write Continental Mfg. Co., 230 Park Ave., New York 17, N.Y. *Registered trademark of E. I. Dupont de Nemours & Co., Inc.

TUFLINE PLUG VALVES

CONTINENTAL MANUFACTURING COMPANY • CINCINNATI 42, OHIO

How to simplify
air conditioning system
water treatment



Here's servicing of air conditioner water in the easiest possible way. A routine 10 minute daily check by one man, and Oakite Airefiner No. 52 ... that's all it takes. You end scale, slime, algae and corrosion troubles. You avoid out-of-service time, and maintain cooling efficiency.

The entire operation is simplicity itself. (1) Charge water initially with economical Oakite Airefiner No. 52. (2) A simple once-a-day check of water tells whether any adjustment is needed. (3) Add upkeep, if necessary. (4) Periodically, drain system and replenish with fresh, charged water.

Oakite Airefiner No. 52 leaves no deposit on tubes, is safe, and costs little for initial charge as well as upkeep.

Call in the local Oakite Technical Service Representative to get details and drawings on this money- and trouble-saving procedure. Or write Oakite Products, Inc., 32D Rector Street, New York 6, N. Y.

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Export Division
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WATER TREATING
materials

Technical Service Representatives in Principal Cities of U. S. and Canada

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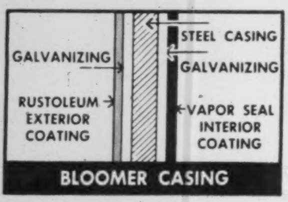
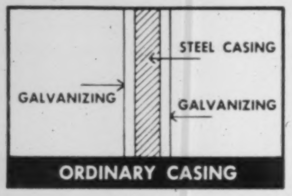
COOLING TOWERS

QUALITY . . . at a competitive PRICE

5 thru 550 Tons in a Single Cell



BLOOMER CASING



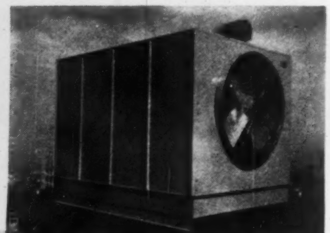
ORDINARY CASING

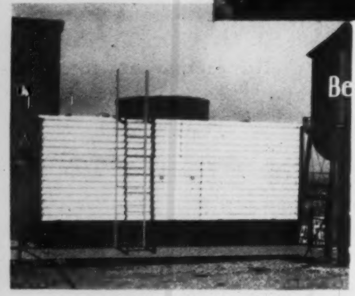
All models thru 200 tons can be shipped factory-assembled for job-site delivery by truck.

All models available knocked-down for easy field erection.

Experienced engineering assistance available.

Single Flow Models 5 thru 80 Tons





Double Flow Models 80 thru 550 Tons

FISKE COMPANY
1233 W. 47th St. Chicago 9, Ill.
Send FREE catalog on BLOOMER COOLING TOWERS

Company ____________________

Individual ____________________

Address ____________________

MEETINGS & CONVENTIONS

MAY 9-12 — *Mechanical Contractors Association of America Annual Convention.* Fountainebleau Hotel, Miami Beach. Information: MCAA, Suite 570, 45 Rockefeller Plaza, New York 20.

WEEK OF MAY 15 — *Annual Meeting of the National Fire Protection Association.* Statler Hilton Hotel, Detroit. Information: NFPA, 60 Batterymarch St., Boston 10.

MAY 16-18 — 1961 *Spring Conferences of the Building Research Institute.* Shoreham Hotel, Washington, D.C. Information: Harold Horowitz, BRI, 2101 Constitution Ave., Washington 25, D.C.

MAY 21-23 — *Spring Meeting, Fluid Controls Institute, Inc.* The Cloister, Sea Island, Ga. Information: FCI, P.O. Box 667, Pompano Beach, Fla.

JUNE 4-9 — *Seminar on Electrical Precipitation.* The Pennsylvania State University, University Park, Pa. Information: Conference Center, The Pennsylvania State U., University Park, Pa.

JUNE 8-9 — *First Western Conference, National Electrical Manufacturers Association.* The Biltmore Hotel, Los Angeles. Information: NEMA, 155 E. 44th St., New York 17.

JUNE 11-15 — *The 54th Annual Air Pollution Control Association Meeting.* Hotel Commodore, New York. Information: Sheldon W. Samuels, director of public information, New York State Air Pollution Control Board, 84 Holland Ave., Albany 8, N.Y.

JUNE 11-15 — *American Society of Mechanical Engineers Summer Annual Meeting.* Statler-Hilton Hotel, Los Angeles. Information: ASME, 29 W. 39th St., New York 18.

JUNE 12-15 — *National District Heating Association, 52nd Annual Meeting.* Wentworth-by-the-Sea, Portsmouth, N.H. Information: John F. Collins, Jr., secretary-treasurer, NDHA, 827 N. Euclid Ave., Pittsburgh 6.

JUNE 12 — *Air Pollution Instrumentation Symposium,* in conjunction with the *JUNE* 12-16 *Annual Meeting of the Air Pollution Control Association.* Sponsored by ISA and APCA, Hotel Commodore, New York. Information: APCA, 4400 Fifth Ave., Pittsburgh 13.

Accuracy . . . in the shop or in the field is the trademark of H & M Pipe Cutting and Beveling Machines. H & M performance is fast, efficient . . . even under the most rugged conditions. H & M's are easy to operate and untrained personnel become experts after just a few minutes' practice with an H & M Machine.

ACCURACY....

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H & M Machines can put more accuracy . . . more speed . . . more profits . . . into your pipe fabrication. Write today for catalog sheets and price lists on H & M's complete line of machines and accessories.

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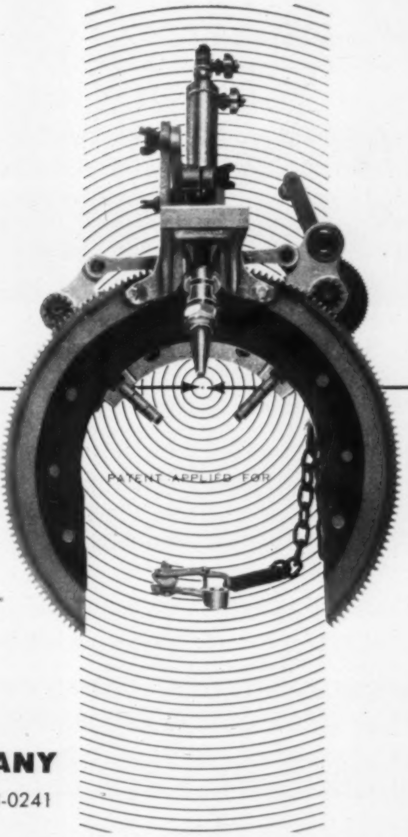

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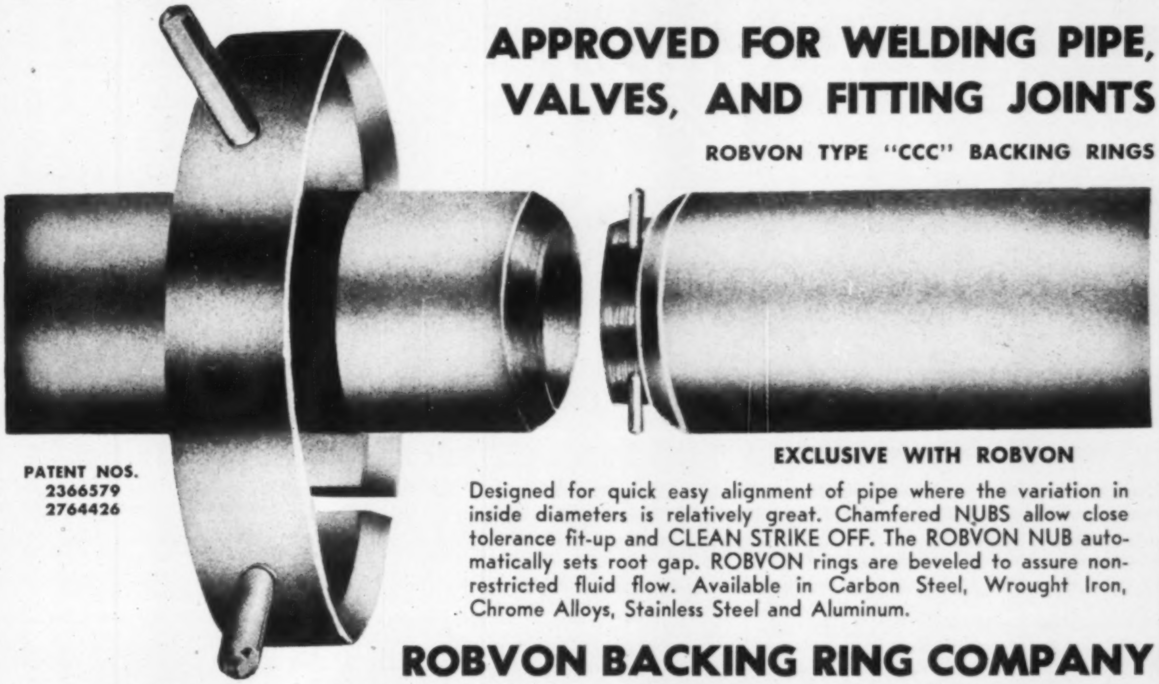
APPROVED FOR WELDING PIPE, VALVES, AND FITTING JOINTS

ROBVON TYPE "CCC" BACKING RINGS



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Designed for quick easy alignment of pipe where the variation in inside diameters is relatively great. Chamfered NUBS allow close tolerance fit-up and CLEAN STRIKE OFF. The ROBVON NUB automatically sets root gap. ROBVON rings are beveled to assure nonrestricted fluid flow. Available in Carbon Steel, Wrought Iron, Chrome Alloys, Stainless Steel and Aluminum.

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MEETINGS & CONVENTIONS

Continued

JUNE 19-23 — Air Cleaning Institute. (see You'll Want to Know, April, page 52, for details) Harvard University School of Public Health, Boston. Information: Leslie Silverman, SC.D., Harvard School of Public Health, 55 Shattuck St., Boston 15.

JUNE 25-30 — American Society for Testing Materials Annual Meeting. Chalfonte-Haddon Hotel, Atlantic City, N.J. Information: ASTM, 1916 Race St., Philadelphia 3.

JUNE 26-28 — American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Annual Meeting. Hilton Hotel, Denver, Colo. Information: ASHRAE, 234 Fifth Ave., New York 1.

JULY 18-20 — Western Plant Maintenance and Engineering Show & Conference. Pan Pacific Auditorium, Los Angeles. Information: Western Office, 759 Monadnock Bldg., San Francisco 5.

JULY 31-AUGUST 11 — Tufts University Summer Institute for Technical Writers and Publishers. Tufts University, Medford, Mass. Information: Mrs. Florence N. Trefethen, assistant director, 8 N. Hall, Tufts University, Medford 55, Mass.

WEEK OF JUNE 12 — The Institute of Boiler and Radiator Manufacturers Annual Meeting. Seaview Country Club, Absecon, N.J. Information: IBR, Room 108, 608 Fifth Ave., New York 20.

AUGUST 14-18 — UA International Apprentice Contest. Purdue University, Lafayette, Ind. Information: United Association of Journeymen & Apprentices of the Plumbing & Pipefitting Industry of the United States and Canada, United Association Building, 901 Massachusetts Ave., N.W., Washington 1, D.C.

AUGUST 21-31 — International Exhibition of New Sources of Energy. To be held concurrently with the *United Nations Conference on New Sources of Energy.* Circo Massimo, Rome. Information: Rassegna Internazionale Elettronica e Nucleare, Via della Scrofa, 14, Rome. (cable address: ROMATOM) Please mark correspondence: International Exhibition of New Sources of Energy.

Centridyne BY WESTERN

The new compact centrifugal roof ventilator. Advanced styling as low as 11½"

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Stainless steel piping for process installations, like the one pictured in Mogen David Wine Company's modern Chicago plant, can be readily supplied from our warehouse stock.

We maintain a large inventory of light-wall, standard, and extra-heavy stainless pipe in a variety of sizes and analyses — plus threaded and welding fittings, and valves.

Rely on C. A. Roberts Co. for prompt service and expert technical assistance on your Stainless Piping requirements.

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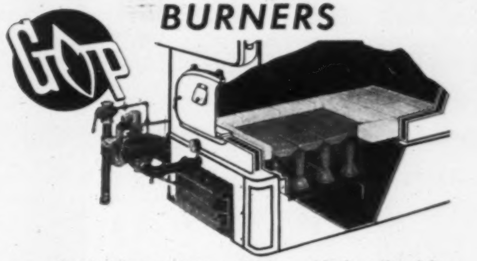
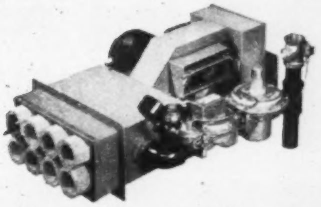
BURNERS



For heating and power boilers. 23 sizes listed in Catalog No. A-10.

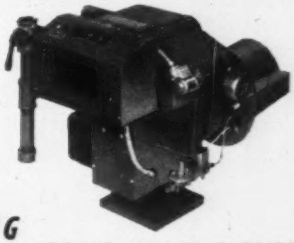
BLUE LINE UPSHOT ATMOSPHERIC GAS BURNER



Fully automatic, packaged assembly. Sizes listed to 28 million BTU/HR in Catalog C-10

TURBO-FIRE POWER TYPE GAS BURNER

MODEL R
Capacities up to
2¼ million BTU/HR
Catalog E-61

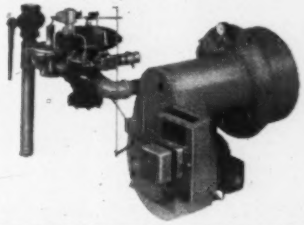


TURBO-RING

FORCED DRAFT BURNERS

Gas, oil, or combination Gas-Oil burner. No stack required on boilers equipped for pressure firing.

MODEL FGR
Capacities 1 to 9
million BTU/HR
Catalog E-51



* PLANNED — Factory assembled, pre-wired for "Bolt-in" installation.

* PERFORMANCE — Custom matched to individual boilers for quiet, efficient operation.

Gordon & Piatt also manufacturer of a complete line of domestic conversion burners plus large dual-fuel units. Write for literature and complete information.

Gordon & Piatt

P. O. Box 914
Winfield, Kansas

FOR **SIMPLIFIED INSTALLATION**

AND **COMFORTABLE ROOM HEAT**

USE **SHAW Panel-Vectors**

Cut-open view of Model A Panel-Vector

Shaw Panel-Vectors are of rigid, fully-integrated construction, delivered ready to install. There are no dampers or separate housings to fit and hang. Choice of same end or opposite end tapping offers opportunities for important piping simplification and economies.

Panel-Vectors distribute a *low-temperature*, unvarying combination of radiant and convected heat that only Nature—at her best—can rival. Stratification, and areas of extreme heat or chill are eliminated . . . room occupants are not only warm, they are *comfortably* warm.

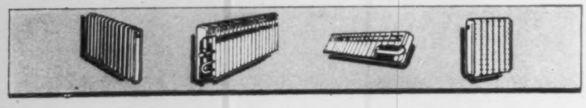
Shaw Panel-Vectors use hot water or steam up to 150 psi. They are available in wall-hung (panel) or baseboard models, each a space-saving 3″ deep. There is a full range of sizes to meet any room-heat distribution requirement.

Find out today about Shaw Panel-Vectors—the radiators that give you simplified installation, give the owner *comfortable* heat. Write for free literature on wall-hung and baseboard models.

SHAW-PERKINS MFG. CO.

Properly Designed Room Heat Distribution Equipment

201 E. CARSON ST., PITTSBURGH 19, PENNA.



MEETINGS & CONVENTIONS

Continued

SEPT. 27-OCT. 4 — The Institute of Heating and Ventilating Engineers, International Conference on Heating, Ventilating and Air Conditioning. London, England. Information: F. L. Rossetti, secretary, Conference Coordination and Management Committee, 49, Cadogan Sq., London, S.W.1.

OCT. 1-4 — 43rd Annual Meeting, American Gas Association. Registration, Dallas Municipal Auditorium; various sessions at the Statler Hilton, Sheraton-Dallas, Adolphus, and Baker hotels, Dallas. Information: AGA, 420 Lexington Ave., New York 17.

OCT. 7-10 — Western Building Industries Exposition. Great Western Exhibit Center, Los Angeles. Information: WBIE, 2216 S. Hill St., Los Angeles 7.

OCT. 16-17 — International Conference on Air Ionization. Franklin Institute, Philadelphia. Information: American Institute of Medical Climatology, 1618 Allengrove St., Philadelphia 24.

NOV. 12-15 — Air-Conditioning and Refrigeration Institute Annual Meeting. The Homestead, Hot Springs, Va. Information: ARI, 1346 Connecticut Ave., N.W., Washington 6, D.C.

NOV. 13-16 — National Warm Air Heating and Air Conditioning Association Annual Convention. La Salle Hotel, Chicago. Information: NWAHACA, 640 Engineers Bldg., Cleveland 14.

NOV. 26-DEC. 1 — The American Society of Mechanical Engineers Winter Annual Meeting. Statler Hilton Hotel, New York. Information: L. S. Dennegar, director of public relations, ASME, 29 W. 39th St., New York 18.

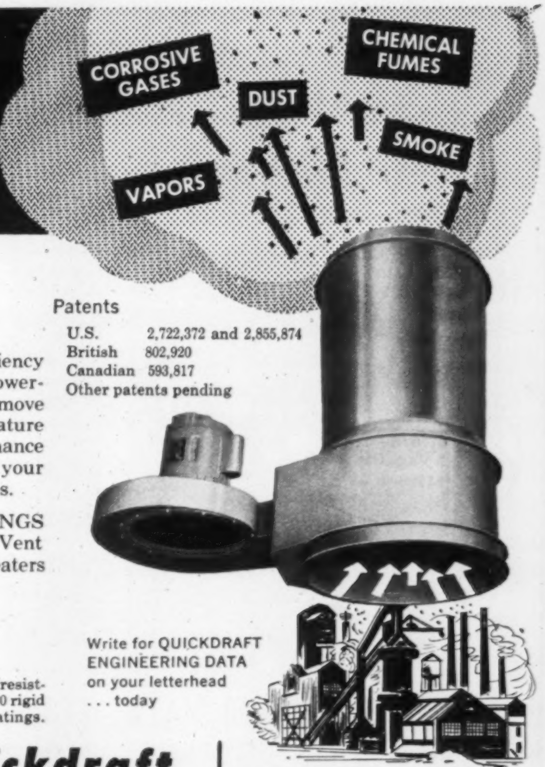
1962

FEB. 12-15 — Air Conditioning and Refrigeration Industry 12th Exposition. Pan-Pacific Auditorium, Los Angeles. Information: George E. Mills, ARI Show Director, ARI, 1346 Connecticut Ave., N.W., Washington 6, D.C.

HIGHER COMBUSTION EFFICIENCY!
LOWER MAINTENANCE COSTS!

NO MOTORS, FANS OR BEARINGS IN EXHAUST LINE

PERFECT DRAFT-CONTROL BY **Quickdraft**

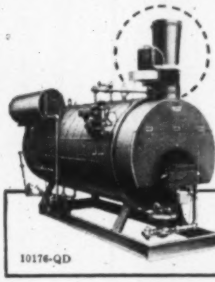


Patents
U.S. 2,722,372 and 2,855,874
British 802,920
Canadian 593,817
Other patents pending

★ EXTREMELY HIGH NEGATIVE PRESSURES
★ ACID RESISTING FINISHES
★ HIGHLY EFFICIENT WITHOUT CHIMNEY

FOR INDUSTRY . . . Now you can boost the combustion efficiency of your boilers, regardless of the fuel you use. Quickdraft power-draft units provide instant controlled draft and completely remove all combustion, corrosive and noxious fumes at high temperature without passing them through the blower and motor. Maintenance costs are drastically reduced. Specify a Quickdraft unit to meet your particular requirements from a wide selection of various sizes.

FOR INSTITUTIONAL AND COMMERCIAL BUILDINGS . . . Quickdraft eliminates costly, tall and unsightly stacks. Vent incinerators, heating plants and water heaters at roof level . . . safely and efficiently.



FOR CORROSIVE SERVICE

All Quickdraft units are available in standard acid resisting vitreous enamel, 316 stainless steel, carpenter 20 rigid plastics (P.V.C), and with plastic or Fiberglas coatings.

One of many actual installations with or without chimney.

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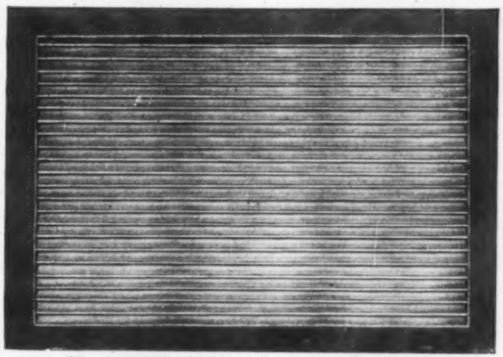
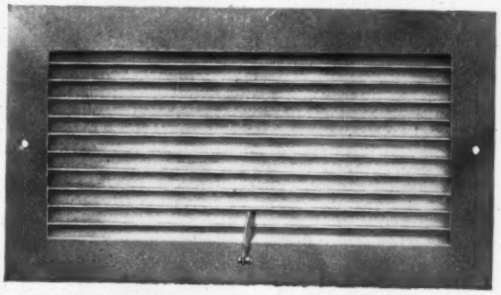
P.O. Box 87-K, Canton 1, Ohio

MANUFACTURERS OF ALL TYPES OF MATERIAL HANDLING UNITS WITH EXTREMELY HIGH VELOCITIES.



No. A-760-B All Aluminum, No-Vision Grille



No. A-76-B All Aluminum, Shut-Off Type, No-Vision Grille

A-J NO-VISION ALL ALUMINUM GRILLES

Fixed and Shut-Off Types

NEW! The A-J No. A-760 and A-76 Series no-vision grilles, being only 13/16″ thick, have no bulky depth to extend beyond door thickness. Excellent for duct installation for supply and return air. Louvers are on ½″ centers, and are completely sightproof from any angle. Free area is approximately 48%. Corrosion and rust-proof. Requires no upkeep. Satin finish is standard.

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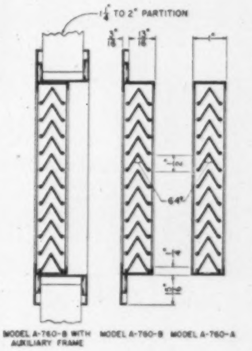
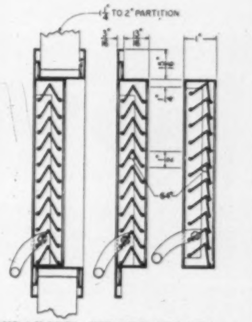
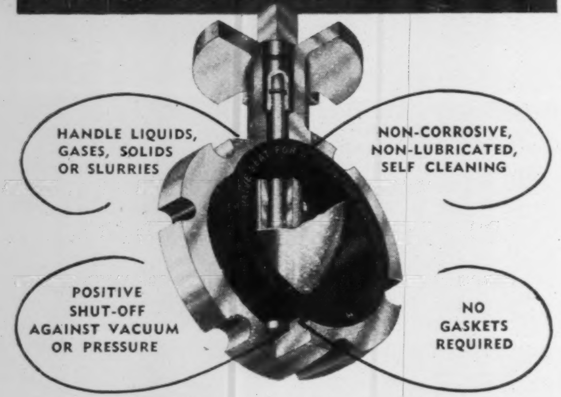




A-J Manufacturing Co.

Dept. H-5 3601 East 18th Street Kansas City 27, Missouri

MULTI-PURPOSE KEYSTONE VALVES


HANDLE LIQUIDS, GASES, SOLIDS OR SLURRIES
NON-CORROSIVE, NON-LUBRICATED, SELF CLEANING
POSITIVE SHUT-OFF AGAINST VACUUM OR PRESSURE
NO GASKETS REQUIRED

KEYSTONE VALVES handle an almost unlimited variety of flow control services. Their many features reduce your valve costs, simplify maintenance problems, give you the utmost in dependability under all conditions. Sizes, 1" through 48", with lever, gear or power actuators. WRITE FOR DETAILED INFORMATION.

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Representatives in principal cities throughout the world.

The ORIGINAL Design
Bubble-Tight Closure • No Gaskets Required • Securely Fastened Seats

you get **UNEQUALLED SERVICE**

with **ROYALTON** expansion joints

ROYALTON Expansion Joints provide a ruggedly simple and economically efficient solution for thermal expansions in pipelines.

- pressures to 300 psi G; temperatures to 750° F; sizes 2" to 20" dia.; traverse up to 12" per slip
- non-ferrous internal guide ring keeps slip from other metal parts
- chemically inert packing unusually durable and resilient
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Removal of Organic Contaminants from Air by Type 13X Molecular Sieve — A report of a study made on the adsorption of low concentrations of n-decane, methane, benzene, toluene, xylene, pyridine, aniline, and nitrobenzene on type 13X molecular sieve at influent concentrations of from 5 to over 100 ppm and superficial linear velocities of up to 3000 cm per min. Study conducted by P. Gustafson and S. H. Smith, Jr., U. S. Naval Research Laboratory. *Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce, Washington* 25, *D.C.* Price, 50 cents.

The Mechanical Estimator's Guide, 1961 *Edition* — This guide is a collection of labor and material cost data for air conditioning of all descriptions. Data is included for cooling towers, activated charcoal, chilled water units, walk-in coolers, service reserves, pipe, grilles, heating equipment, concrete pads, tools, and labor saving devices. Plastic bound volume was written by John Gladstone. It has 156 pages. *Technical Guide Publications, Inc.,* 221 *N.E. 59th St., Miami* 37. *Fla.* Price, $6.95.

Advances in Cryogenic Engineering — The science dealing with low-temperature phenomena is explored further in this volume which is number six in a series. Contains 65 technical papers by leading scientists in the cryogenic engineering field. The reports are divided into the following general sections: Space Technology; Applications; Superconductivity; Processes; Transfer Phenomena; Equipment; Physical Equilibria and Related Properties; Heat Transfer and Thermometry; and Mechanical Properties. *Plenum Press, Inc.,* 227 *West 17th St., New York* 11. Price, $15.00.

18 *Questions and Answers About Radiation* — A brief and non-technical discussion of nuclear radiation and radioactivity prepared by the U.S. Atomic Energy Commission. *U.S. Atomic Energy Commission, Washington 25, D.C.*

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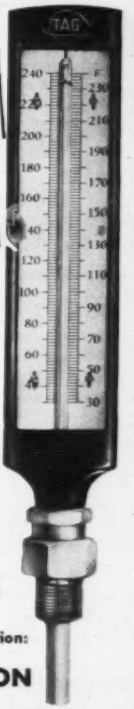

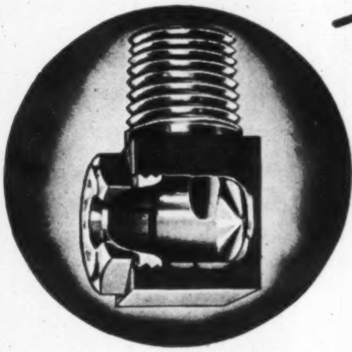

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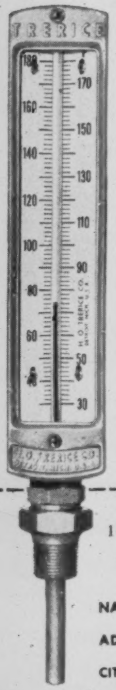

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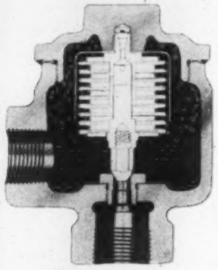

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Directory of Manufacturers' Representatives (Agents), 1961 — Directory lists more than 15,000 manufacturers' domestic and export representatives in the United States, Canada, and Puerto Rico. Listings are arranged geographically and include the principal products each representative carries and the trading area covered. Prevailing commission scales for various products and suggested manufacturer-representative contract forms are included. Volume has 217 pages. *Manufacturers' Agent Publishing Co., 554 Fifth Ave., New York* 36. Price, $20.00.

Economics of Nuclear Power — A bibliography on the economics of nuclear power prepared by the U.S. Atomic Energy Commission. Containing 518 selected references to research reports, articles, technical and scientific papers, the 82 page bibliography covers literature on the development of economic nuclear power for industry. Material is included on construction of power stations and reactors, materials used, processes employed, and other factors important in making economic evaluations. *Office of Technical Services of the Business and Defense Services Administration, U.S. Department of Commerce, Washington 25, D.C.* Price, $2.00.

Gas Air Conditioning Sales Reference Manual — A 350 page book for use as a training aid and as a reference source for salesmen. Published in loose-leaf form, it contains numerous tables and illustrations. *American Gas Association, Order and Billing Department, 420 Lexington Ave., New York* 17. Price, $9.00.

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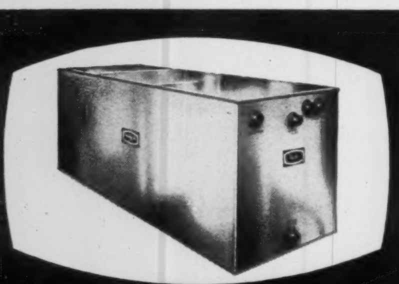

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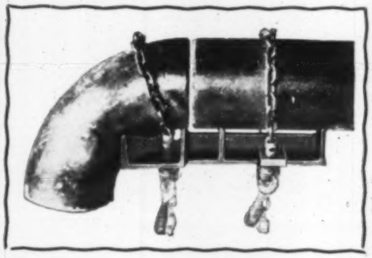

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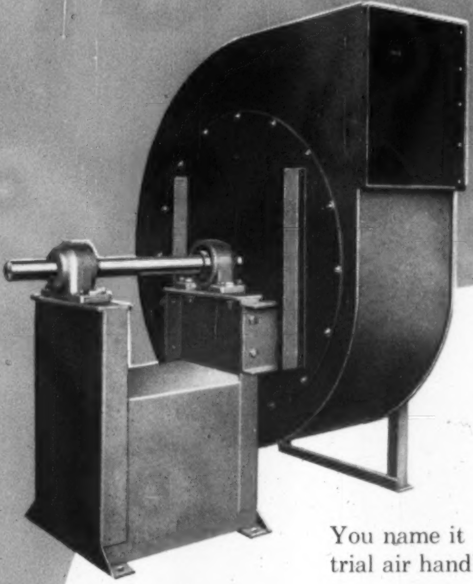

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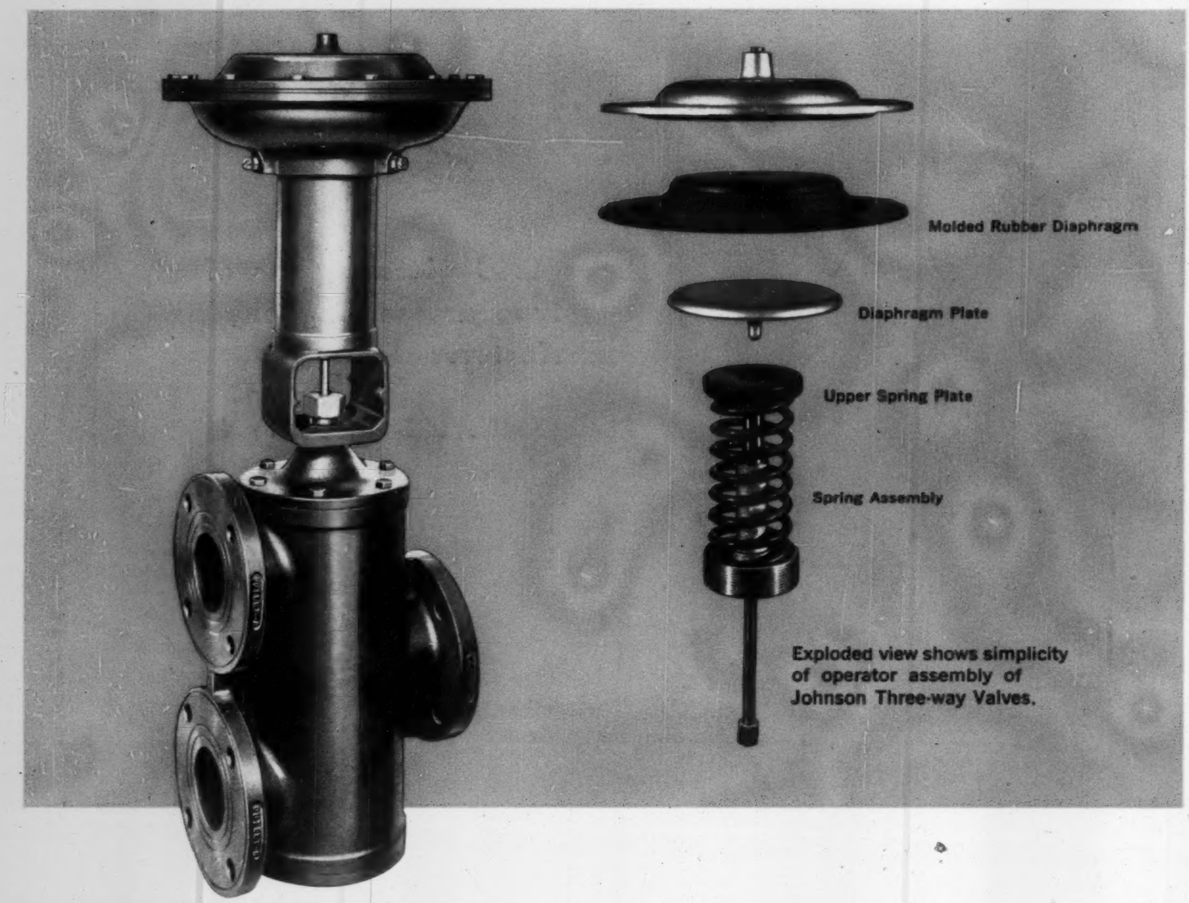

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